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ABSTRACT

Two studies were devised to test the relationship between response mode, trait and state anxiety, and achievement in a computer-assisted instruction (CAI) course containing both familiar and technical materials. In the first study, 148 subjects were divided into four response mode conditions: reading (R), covert, modified multiple choice, and constructed response (CR). All subjects were given a pretest, several administrations of two anxiety scales, the CAI administered material, and a posttest. Results showed that high trait and high state anxiety were associated; the CR group had significantly higher anxiety scores on technical materials; and the CR and R groups performed at the same level on technical materials, perhaps because the CR group was made more hostile by the length of time required to learn the materials. For the second study, 128 students were divided into four groups: reading-short, reading-long, constructed response-short, and constructed response-long. Procedures were the same, with the addition of a hostility measure. The findings of this study were similar to those of the first study: High trait and state anxiety were associated, and the CR groups had higher levels of anxiety and hostility and poorer performance on technical materials than the R groups. (SH)

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SUMMARY

The funded research consisted of two studies which focused on the process of anxiety within learning. The importance of this topic is reflected in the extensive literature which indicates the anxiety can interfer with the learning process (Spielberger, 1966; Sarason, 1970). As a result, the students level of achievement is not commensurate with this intellectual aptitude and his confidence of his own ability is seriously undermined.

The research extended and knowledge of the impact of anxiety on learning by considering the relationships between anxiety and overt responding to computer-assisted learning materials. In addition, the role of anxiety with different types of learning materials such as problem solving materials that use graphics was also investigated. A CAI situation was chosen as the bases of this research as it provided a context that permitted the presentation materials under carefully controlled conditions, that are more relevant to the real life needs of a student than is usually possible with additional laboratory tasks. An additional advantage for CAI is that it is also possible to measure anxiety as well as subjects' responses to meaningful learning materials.

The measurement of anxiety as learning progresses enables the investigator to determine in finer detail the exact nature of the relationship between anxiety and performance. These capabilities of a CAI approach help to bridge the gap between laboratory research on anxiety and learning, and applications of learning principles in the classroom.

Hypotheses about the effects of anxiety of learning were derived from Spence-Taylor Drive Theory and Spielberger's Trait-State Anxiety Theory. These theories also provide the conceptual framework within which research on anxiety and computer-assisted learning was examined.

Thus, the purpose of the present funding was to test the generality of the conclusions from prior computer-assisted learning and anxiety research and in addition, sought new information on the effects of response modes, anxiety states, and achievement on CAI learning materials.

In the first study (Study I) the effects of trait and state anxiety levels (low, medium, and high) and response modes (reading, covert, modified multiple choice, and constructed response) on posttest achievements for familiar and technical materials dealing with heart disease were investigated. The learning materials were presented to 148 subjects via an IBM 1500 computer-assisted instruction system.

High trait anxiety was associated with high A-State anxiety for all groups. Whereas prior programmed instruction research using the same materials indicated that the constructed response mode would lead to superior performance compared to a reading mode on technical materials, Study I found no differences between a constructed response and reading groups presented the same materials via CAI.

The failure of Study I to replicate the programmed instruction findings may have been due to the fact that students in the constructed response group had significantly higher state anxiety during the technical materials and posttest than the reading group. In addition, the constructed response group took over twice as long as the reading group to finish the CAI materials. Moreover, negative debriefing comments by the constructed response group indicated that they may have been more hostile than the reading group. Thus, the average time of two hours on the CAI task for the constructed response group associated with higher state anxiety and perhaps hostility may have served to depress their posttest performance.

Study II sought to replicate the findings of the first study and to also reduce state anxiety and improve performance by shortening the amount of time spent on the instructional materials. One hundred and twenty-eight students were presented two forms of the verbal and graphical materials, a reading version and a constructed response version. In addition, long and short versions of these materials were used. Hostility was measured to explicate and extend the previous findings.

The findings of Study II which replicated those of Study I, include the finding that in general high A-Trait students had higher levels of A-State throughout the experimental tasks than either medium or low A-Trait students thus supporting Trait-State Anxiety Theory predictions. In addition, the A-State analyses of both Study I and II indicated that A-State scores decreased for both the reading and constructed response group from the pre measure to the familiar measure and remained relatively constant for the reading group following technical A-State measure. Further students in the constructed response groups were found to have high levels of A-State during the posttest than students in the reading groups in both studies I and II.

Regarding the replicated performance results neither levels of A-Trait nor level of A-State affected student performance on the pretest. Results of the posttest performance in studies I and II indicated that students in the reading groups performed better than students in the constructed response groups on the familiar portions of the posttest. With respect to total time required to learn the instructional material, subjects in the constructed response group in general took approximately twice as long to learn the instructional materials as subjects in the reading groups.

Although it was hypothesized that shortening program length would lead to reductions in level of A-State particular those students in the constructed response short version, this hypotheses was not supported in Study II.

It was further hypothesized that shortening program length would improve the posttest performance of students in the constructed response short group relative to the performance in the reading short group. Relevant to this hypothesis was the finding that students in the short and programmed versions performed significantly better than students in the longer versions on the familiar posttest. Moreover, their significant interaction between response modes and programmed lengths on familiar posttest indicated that whereas there was real difference in the performance of students in the long and short reading group students in the short constructed response version performed significantly better than students in the long constructed response versions.

In addition, there was a significant interaction between levels of A-State response modes, and program lengths on the familiar portion of the posttest which indicated that level of A-State was not as debilitating to performance of students in the short constructed response version relative to the performance of students in the long constructed response version.

Analyses of the performance of students on the initial technical posttest failed to support this hypotheses that shortening instructional time would improve performance. Thus, shortening program length was only partially effective in improving the performance of students on the posttest.

With respect to the hostility findings it was found as predicted that students in the constructed response groups had higher hostility scores than students in the reading groups. Contrary predictions, however, shortening program lengths did not affect the hostility scores of the students.

With respect to the A-State findings of Study II which did not replicate those of Study I, it should be noted that the A-State measure used in Study I and II were not directly comparable. With respect to performance results of studies I and II, several findings failed to replicate. First the interactions involving A-Trait levels of response modes on the familiar posttest went in opposite directions. Thus, Drive Theory as an explanatory theory for these anxiety and performance results must be extended to take into account possible content related variables.

In summary, the findings of both Study I and II indicated that the impact of the constructed response mode variable paramount in that students in this response mode condition had high levels of anxiety,

hostility and poorer performance of the total technical posttest than students in the reading groups. The major findings of both studies in general supported Trait-State Anxiety Theory and replicated the effects of response modes on state anxiety and performance in the CAI task. However, the instructional treatment of shortening time spent on the CAI task was not effective in reducing state anxiety.

The present findings, therefore, seem to indicate that it is not instructional time per se, as the critical variable for reducing state anxiety and improving performance. The intrinsic differences in the nature of the CAI learning task for the constructed response and reading groups, including their differential affective and cognitive effects, imply the need to direct research efforts to study more relevant task variables.

The findings also lead to suggesting future research in this area, i.e., the reduction of anxiety in learning. Future research should be concerned with an investigation of anxiety reduction techniques on anxiety levels and performance. These techniques should range from instructional to clinical treatments and should be investigated in a range of computer-based situations.

Introduction

The funded research which consisted of two studies focused on the process of anxiety within learning. The importance of this topic is reflected in the extensive literature which indicates that anxiety can interfere with the learning process (Spielberger, 1966; Sarason, 1960). As a result, the student's level of achievement is not commensurate with his intellectual aptitude, and his confidence of his own abilities is seriously undermined.

The research extended the knowledge of the impact of anxiety on learning by considering the relationships between anxiety and overt responding to CAI learning materials. In addition, the role of anxiety with different types of learning materials such as problem solving materials that use graphics was also investigated. The importance of extending research in these directions related to the need for testing both Drive Theory (Spence, 1958; Taylor, 1956) and Trait-State Anxiety Theory (Spielberger, Lushene, & McAdoo, 1969) as theoretical explanations for a wide number school learning behaviors.

A CAI situation was chosen as the basis for this research as it provided a context that permitted the presentation of materials under carefully controlled conditions that are more relevant to the real life needs of the S than is usually possible with traditional laboratory tasks. An additional advantage for CAI is that it is also possible to measure anxiety as well as the Ss' response to meaningful learning materials (O'Neil, 1969). The measurement of anxiety as learning progresses enables the investigator to determine in finer detail the exact nature of the relationship between anxiety and performance. These capacities of the CAI approach help to bridge the gap between laboratory research on anxiety and learning and applications of learning principles in the classroom.

Hypotheses about the effects of anxiety on learning were derived from Spence-Taylor Drive Theory and Spielberger's Trait-State Anxiety Theory. These theories also provided the conceptual framework within which research on anxiety and computer-assisted learning was examined. The background and current status of both theories are reviewed below.

Drive Theory

In order to study the effects of anxiety on learning, a theory of learning that specifies the complex relationships between anxiety and performance is needed. Drive Theory, as formulated by Spence (1958) and Taylor (1956), is especially useful for this purpose because

it attempts to integrate associative and motivational variables in learning. In this theory, anxiety is equated with Hull's (1943) concept of Drive (D); level of D is usually inferred from scores on the Taylor Manifest Anxiety Scale (1953). It is generally assumed that individual differences in TMAS scores reflect differences in D.

In Drive Theory, there are three major assumptions concerning the learning process. First, it is assumed that both correct and erroneous response tendencies are evoked by a learning task, and that the latter continue to be elicited even as the correct response is learned. Second, Drive Theory posits that both correct responses and competing error tendencies are multiplied by D. Third, it is assumed that performance is jointly determined by level of D and the relative strengths of correct and competing response tendencies.

With regard to the effect of anxiety (D) on learning, Drive Theory predicts that the performance of high anxious Ss will be inferior to that of low anxious Ss on complex or difficult learning tasks in which competing error tendencies are stronger than correct responses. In contrast, on simple learning tasks, in which correct responses are dominant relative to incorrect response tendencies, it would be expected that the performance of high anxious Ss would be superior to that of low anxious Ss. Although the findings of most studies utilizing the TMAS as a measure of D have provided support for Drive Theory (e.g., Lucas, 1952; Montague, 1953; Raymond, 1953; Spence, 1964; Spence, & Spence, 1966; Taylor, & Chapman, 1955), some investigators have reported results inconsistent with predictions from this theory (e.g., Hughes, Sprague, & Bendig, 1954; Kamin, & Fedorchak, 1957; O'Neil, 1970).

Trait-State Anxiety Theory

Research on anxiety and learning guided by Drive Theory has suffered from ambiguity with regard to the status of anxiety as a theoretical concept. Spielberger (1966) has emphasized the necessity to distinguish between anxiety conceptualized as a transitory state and as a relatively stable personality trait. According to Spielberger (1966, pp. 16-17):

> Anxiety states (A-state) are characterized by subjective consciously perceived feelings of apprehension and tension, accompanied by or associated with activation or arousal of the autonomic nervous system. Anxiety as a personality trait (A-trait) would seem to imply a motive or acquired behavioral disposition that predisposes an individual to perceive a wide range of objectively nondangerous circumstances as threatening, and to respond to these with A-state reactions disproportionate in intensity to the magnitude of the objective danger.

Most previous studies of anxiety and learning have used measures of anxiety such as the TMAS to select Ss on the assumption that those with high scores were higher in D than those with low scores. Since the TMAS appears to be a measure of trait anxiety (Spielberger, 1966), this procedure is questionable in that the concept of D is logically more closely associated with A-State than with A-Trait.

Drive Theory specifies the effects of individual differences in D on performance in learning experiments. It seems more reasonable, however, to infer differences in D from measures of A-State than by selecting Ss who differ in A-Trait. Trait-State Anxiety Theory augments Drive Theory's predictions about performance in learning experiments by specifying the conditions in which Ss differing in A-Trait will be expected to show differences in A-State. The extent to which Drive Theory is supported in the research literature is probably due to the fact that most studies in the Drive Theory tradition typically expose Ss, selected on the basis of an A-Trait measure, to ego-involving or failure instructions which induce differential levels of A-State in persons who differ in A-Trait.

In the next section, Trait-State Anxiety Theory and Drive Theory will be utilized as a conceptual framework for evaluating and interpreting findings from the anxiety literature that are most relevant to computer-assisted learning.

The Effect of Anxiety on Computer-Assisted Learning

Computer-Assisted Instruction (CAI) implies a set of procedures in which a computer is employed to control the selection, sequencing, and evaluation of instructional materials (Fishmen, Keller, & Atkinson, 1968). In CAI systems, a computer in an instructional role interacts with a S.

Since research on CAI grows out of earlier work on Programmed Instruction (PI), findings concerning anxiety and PI can be generalized to CAI. The results of PI studies have provided some support for Drive Theory. For example, Kight and Sassenrath (1966) and O'Reilly and Ripple (1967) found that high anxious subjects performed poorer than low anxious subjects on difficult tasks. Chapeau (1968) reported similar findings for females but not for males. In contrast, Tobias and Williamson (1968) found no differences between high and low anxious subjects in performance on difficult and easy PI tasks. It should be noted, however, that none of these investigators actually measured state anxiety or D in the experimental situation.

In two recent studies, specific hypotheses derived from Drive Theory and Trait-State Anxiety Theory were tested with computer-assisted learning materials. O'Neil, Spielberger, and Hansen (1969) investigated the relation between A-State and performance for college subjects who

learned meaningful mathematics materials presented by an IBM 1440 CAI system (IBM, 1965). The state anxiety measures were changes in systolic blood pressure and scores on the A-State scale of the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, & Lushene, 1970). Both A-State measures increased while subjects worked on difficult learning materials and decreased when they responded to easy materials. Moreover, subjects with high STAI-A-State scores made more errors on the difficult materials and fewer errors on the easy materials, than did low A-State subjects, as would be predicted by Drive Theory.

These findings were extended by O'Neil, Hansen, and Spielberger (1969). The results of this study confirmed the findings of the earlier study in that: 1) A-State scores increased while subjects worked on difficult materials and decreased when they responded to easy materials; and 2) high A-State subjects made significantly more errors on the difficult materials than low A-State subjects. Although there was no relation between A-Trait and performance, HA subjects responded throughout the learning task with higher levels of A-State than LA subjects.

In both CAI studies, the finding that performance on the learning task was an interactive function of level of A-State and task difficulty was consistent with Drive Theory. These results also provide support for Trait-State Anxiety Theory by demonstrating the need to: 1) distinguish between A-Trait and A-State; 2) obtain measures of A-State in the experimental situation; and 3) infer differences in D from measures of A-State rather than from measures of A-Trait.

On the assumption that the CAI situation involved some threat to self-esteem, Trait-State Anxiety Theory would pretict that the magnitude of increase in A-State would be greater for HA subjects than LA subjects, but this expectation was not confirmed in the study in which subjects were selected on the basis of extreme A-Trait scores. A possible explanation is that while the CAI task was stressful because it was difficult, it was not necessarily more stressful for HA subjects than for LA subjects because it did not evaluate the adequacy of the subject's performance relative to others. If explicit negative evaluations concerning performance were given by the computer, then HA subjects might be expected to perceive the CAI situation as more threatening than LA subjects, and to respond with higher levels of A-State.

O'Neil (1969) investigated this interpretation of the effects of negative evaluations on state anxiety and on performance. Female introductory college students who differed in anxiety proneness (A-Trait) were used as Ss. HA Ss in the stress condition showed a significantly greater initial increase in A-State from pretask levels than did the LA Ss. During the learning task, HA Ss in the stress condition showed a marked decline in A-State whereas level of A-State remained relatively constant for LA Ss. In the nonstress condition, both groups showed almost the same increase in A-State from pretask levels and approximately parallel changes in the level of A-State during the CAI learning task.

Ss with high levels of A-State made more errors than low A-State Ss throughout the learning task. The differences in the performance of high A-State and low A-State Ss were significant on the easier sections of the CAI task, but not for the most difficult part of the task. These relationships between A-State and errors differed from previous research (O'Neil, Hansen, & Spielberger, 1969).

All of the Florida State University (FSU) anxiety and CAI studies (O'Neil, Spielberger, & Hansen, 1969; O'Neil, Hansen, & Spielberger, 1969; and O'Neil, 1970) have highlighted the need to distinguish between A-Trait and A-State, to infer differences in D from measures of A-State rather than from measures of A-Trait and to obtain measures of A-State in the CAI situation. However, these conclusions have been generated by using a single set of CAI mathematical learning materials. The generality of these conclusions were tested in the two funded studies by using verbal and graphical learning materials rather than mathematical ones.

Tobias (1968) has developed such a set of materials. His PI materials dealt with two types of content; first, familiar materials dealing with the incidence and risk of contracting heart disease and second, technical materials concerning the diagnosis of myocardial infarction. The latter materials require either a verbal response or a graphical one and were unfamiliar to his Ss.

Tobias (1968) investigated with these materials, the interaction between individual difference variables, response mode to PI and the degree to which the materials were familiar to the Ss. He predicted that the constructed response mode would lead to higher achievement on technical, unfamiliar materials, but not on familiar materials, than reading the program cast in the form of completed statements. His results showed that there were no significant differences between his constructed response group and a reading group on the familiar materials but these groups differed significantly on both types of technical materials.

These results replicate the work of Cummings and Goldstein (1963) who used an earlier version of a technical part of Tobias PI program. They found that their constructed response group achieved significantly more for the graphical and verbal technical materials than a covert response group. Thus, similar to Tobias' results, a strong relationship between response mode and performance on graphic technical materials was observed.

Tobias (1968, p. 37) hypothesized that these response mode and graphics relationships may be due to the fact that the

> "electrocardiagrphic tracings which compose the greater bulk of the pictorial (graphic) responses in the present study required Ss to make an enormous number of differentiations between tracing of superficially similar characteristics. It would appear that the best way to make these differentiations is by actually drawing tracings with different characteristics."

Thus, the purpose of the present funding was to test the generality of the conclusions of O'Neil, Spielberger, and Hansen (1969), O'Neil, Hansen, and Spielberger (1969) and O'Neil (1969) and in addition, sought new information on the effect of response modes, anxiety states, and achievement on CAI learning materials. Our progress to date in this regard is given in the next two sections. In the first section, the first funded study (Study 1) is reported, whereas the second section, the findings of the second funded study (Study II) are reported.

Study I: Effects of Anxiety, Response Mode, and Subject Matter Familiarity on Achievement in Computer-Assisted Learning

On the basis of Trait-State Anxiety Theory, Drive Theory, and Tobias' (1968) findings, the following predictions were made for Study I: 1) High A-Trait (HA) Ss would have higher levels of A-State throughout the task than low A-Trait (LA) Ss, 2) Since A-State has not been measured in any response mode study, no predictions were made concerning A-State levels in the four response modes, 3) High A-State Ss would make fewer correct responses on the achievement measures than low A-State Ss, 4) the CR group would make more correct responses on the technical portion of the posttest, the R group would make the lowest number of correct responses, whereas the C and MMC groups would make an intermediate number of correct responses; 5) response mode groups would differ in total time on the learning materials.

Methods

Subjects. 148 female undergraduate students at Florida State University were used as Ss. These Ss were enrolled in psychology and health education classes in which participation in a learning experiment was a course requirement. The Ss were run in small groups of 8 to 15 Ss; a total of 15 experimental sessions was required to run all groups of Ss. The Ss were randomly assigned to one of four experimental conditions, Reading (R), Covert (C), Modified Multiple Choice, (MMC), or Constructed Response (CR), on the basis of their level of A-Trait, high (HA), medium (MA), or low (LA). The means and standard deviations for the A-Trait data obtained prior to the experiment on Ss subsequently assigned to the four experimental conditions are presented in Table 1. It may be noted that LA, MA, and HA Ss across response mode treatments are well-matched on A-Trait scores.

Apparatus. An IBM 1500 system (IBM, 1967) was used to present the learning materials. Terminals for this system consist of a cathode ray tube (CRT), a light pen, and a typewriter keyboard. The terminals were located in a sound-deadened, air-conditioned room. The STAI A-State scales were presented on the CAI system in order to measure A-State while Ss worked through the learning materials. The CAI system recorded all Ss' responses, including response latencies.

Learning Materials and Program Description. The instructional program used by Tobias, (1968, 1969) entitled Diagnosis of Myocardial Infarction, was presented via CAI. An effort was made to simulate Tobias' PI version with the minimum adaptations required to program the material in the Coursewriter II language. The learning materials and posttest were divided into two sections: 1) Familiar (F) material, with which Ss were expected to have previous familiarity; 2) Technical (T) materials, with which it was assumed that Ss had no previous exposure. These technical materials consisted of: a) Technical Verbal materials, which required verbal responses, i.e., words; and b) Technical Pictorial materials, which required pictorial responses, i.e., simulated drawings.

TABLE 1
Mean A-Trait Scores for LA, MA, and HA
Students in Response Mode Conditions

Groups	Low (LA)	A-Trait Level Medium (MA)	High (HA)
All Groups (N=148)			
Mean	27.82	37.19	47.73
SD	3.13	1.86	5.29
Reading (n=37)			
Mean	28.00	37.56	48.60
SD	3.98	1.77	4.99
Covert (n=37)			
Mean	27.91	37.44	46.40
SD	3.36	1.90	5.60
Modified Multiple Choice (n=37)			
Mean	27.82	36.69	47.60
SD	2.44	1.96	6.79
Constructed Response (n=37)			
Mean	27.55	37.06	47.10
SD	3.01	1.84	4.01

The F material in the learning program consisted of 54 frames which dealt with such topics as the incidence and prevalence of heart disease, the role of various risk factors in increasing the probability of heart disease, and a general definition of what constitutes heart disease. There were 89 frames of technical materials which dealt with the diagnosis of myocardial infarction, types of damage to the heart muscle, and their associated electrocardiogram (EKG) tracings. These learning materials are described in detail by Tobias (1968).

The basic learning program was divided into four versions, each containing exactly the same subject matter and frame structure. These four versions were: 1) Reading (R) version, to which the Ss were not required to make any overt responses, but merely to read each frame successively. Response blanks were filled in and frames asking a question were presented in declarative form. The R version corresponded to the Reading version of Tobias' programmed text; 2) Covert (C) version which contained response blanks and interrogative frames. However, no overt responses were required and the Ss were instructed to merely "think"

their answer to themselves and then signal to obtain the correct answer. 3) Modified Multiple Choice (MMC) version to which overt responses were required in the form of a typed word to response blanks on the Familiar (F) and Technical Verbal (TV) materials. On the Technical Pictorial (TP) material containing EKG drawings and tracings, Ss were required to read each frame and choose one of three or four multiple choice answers before being shown the correct answer. 4) Constructed Response (CR) version which was identical to the MMC version on the F and TV frames, but to which Ss had to respond by "drawing" EKG tracings on the TP frames before receiving the correct answer.

The Ss constructed their graphic responses by special program coding which permitted them to construct successive parts of the drawings by various keyboard dictionary characters. Figure 1 illustrates how Ss in the CR group drew EKG tracings via CAI. For example if if the S was asked to draw the Normal EKG tracing, he referred to a handout of tracing segments (a), and chose the correct sequence of numbers which would construct this tracing (b). He then typed in these numbers one at a time and the normal EKG tracing would appear on the CRT (c). The special instructions and a further description of these program versions will be given in the procedure section.

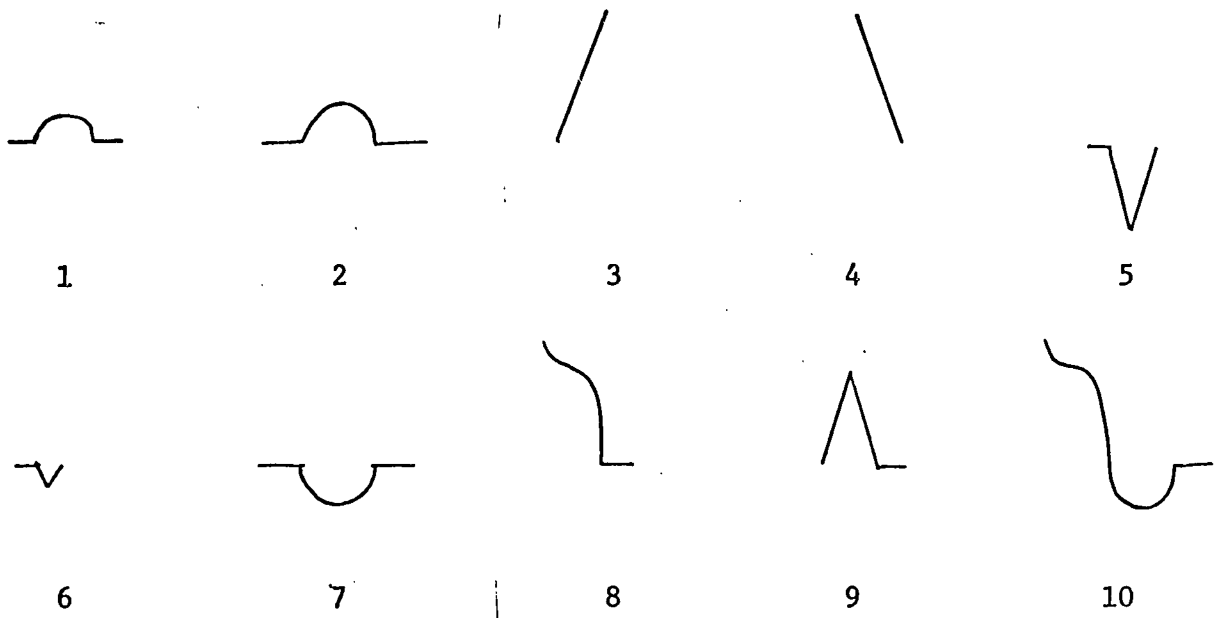
Pre- and Posttests. The pre- and posttests were the same as those used by Tobias (1968, 1969) and were administered to all Ss via paper and pencil. The pretest contained 17 items which covered the Familiar (F) learning materials. The posttest was divided into two sections: 1) the 17 F items included in the pretest, and 2) 14 items which covered the Technical Verbal (TV) and Technical Pictorial (TP) materials. Both the pre- and posttests required constructed responses; for the TP items of the posttest, Ss were required to draw the appropriate EKG tracings and heart damage shadings.

Scoring of the pre- and posttest was based on the criteria set forth by Tobias (1968). Reported alpha reliabilities on the familiar portion of the posttest test was .66; on the technical portion, a reliability of .86 was reported; the reliability of the whole test was reported to be .82 (Tobias, 1968, 1969).

Anxiety Measures. The State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, & Lushene, 1970) was used to measure both state and trait anxiety. The STAI A-Trait scale was used to select Ss with high (HA), medium (MA), and low (LA) levels of A-Trait. The 20-item A-Trait scale was administered with standard instructions, i.e., "indicate how you generally feel." The short form of the STAI A-State scale, which consisted of those five items having the highest item-remainder correlations with the normative sample of the 20-item STAI A-State scale, was administered a total of seven times during the experimental session.[2]

[2] These items were: (1)"I am tense;" (2)"I feel at ease;" (3)"I am relaxed;" (4)"I feel calm;" (5)"I am jittery." Students responded to each item by rating himself on the following four-point scale: (1) "Not at all;" (2)"Somewhat;" (3)"Moderately so;" (4)"Very much so."

A



B Correct sequence of numbers to "draw" Normal ECG tracing: 1, 6, 3, 4, 2

C

Normal ECG tracing

Figure 1. Illustration of how students in CR version "drew" ECG tracings via CAI.

The short form A-State scale was given before and after the achievement pretest via paper and pencil; immediately before the learning materials, immediately following the familiar materials, immediately afterthe technical materials via CAI; and before and after the achievement posttest via paper and pencil. The A-State scales given before the achievement tests and before the beginning of the learning materials were presented with standard instructions, i.e., "indicate how you feel right now." The remaining A-State scales were presented with retrospective A-State instructions, i.e., "indicate how you felt during the task you have just finished." Each of the administrations of the A-State scale had randomly ordered item presentation from scale to scale.

Procedure. The experimental session was divided into three periods: 1) a Pretask period, during which Ss were administered the A-Trait scale, took the achievement pretest and its associated A-State scales, were assigned to response mode group, and read instructions on the operation of the CAI terminal; 2) a Performance Period, during which Ss learned Familiar, Technical Verbal (TV), and Technical Pictorial (TP) CAI materials and took three of the short form A-State scales; 3) a Posttask period, udduring which Ss were administered the achievement posttest, the final A-State measures, and given a debriefing. Each of these periods is further described below.

1. Pretask Period. Upon arrival at the CAI Center, Ss were administered the STAI A-Trait scale with standard instructions. This scale was collected and while being scored, Ss were given the Pretest package containing a short A-State scale to be completed prior to taking the pretest, the 17-item pretest, and a second short A-State scale to be completed following the pretest. The Ss were then assigned to one of the four response mode conditions based on their A-Trait scores: 1) Reading (R), 2) Covert (C), 3) Modified Multiple Choice (MMC), or 4) Constructed Response (CR). The Ss then received written instructions on the operation of the CAI terminals.

2. Performance Period. All Ss were seated at CAI terminals and after "signing on", were presented with introductory materials dealing with the general nature of the experiment. The first short form A-State scale was then presented with standard instructions. Depending upon the response mode conditions to which Ss had been assigned, further instructions were given as to how they should proceed through the learning materials. All Ss were instructed to proceed through these materials at their own rate. Specific instructions given to each of the response mode groups were as follows:

> Reading: "You will not be required to supply an answer to any of the frames. Simply press the space bar to continue on to the next frame. When you have finished the instructional material, you will be given a test on the material."

Covert: "You will not be required to supply an answer to any of the frames. However, you are to think the answer to yourself, then hit the space bar to see the correct answer. When you have finished the instructional material, you will be given a test on the material."

Both the MMC and CR groups received the following instructions for the F and TV materials.

"The material is presented in a series of frames, each of which requires you to give one or more answers. To answer each frame, you must type in the word or number that completes each blank and enter that response. On each frame of the material, when you have filled in all the blanks, the correct answer will appear on the screen before the next frame is presented. You will only be required to respond once to each frame, regardless of whether your answer is right or wrong. When you have finished the instructional material, you will receive a test on the material."

The MMC and CR groups were then given practice in the operation of the keyboard and were instructed on the enter and erase functions. On the TP materials, the MMC group was instructed to merely choose one of three or four alternatives by typing in the correct number; the CR group was given a handout of 10 possible EKG tracing segments and instructed to type in the combination of numbers from 0-9 which would complete the appropriate tracing (see a in Figure 1, p. 10).

During this performance period, all Ss were presented the short form of the A-State scale with retrospective instructions immediately after the familiar materials and following the technical materials.

3. Posttask Period . After each S had completed the instructional program and third CAI A-State scale, he "signed-off" the CAI terminal and was taken to another room in which biographical data was collected. This took approximately 2 minutes after which Ss were given a posttest package containing the short A-State scale to be completed before the achievement posttest, the 31-item posttest, and the short A-State scale to be completed following the posttest.

After the completion of the posttest package, Ss were informed that the task was quite difficult and were reassured that their performance had been satisfactory. The Ss were also given some additional information concerning the general nature of the experiment, and cautioned not to discuss the experiment with their classmates.

Results

For the purpose of clarifying the presentation of findings in the present study, the results will be reported in the following order:

1) Anxiety Data during the Experimental Session; 2) Performance Data on Pre- and Posttest Achievement Measures; 3) Learning Time Data during the Instructional Materials; and 4) Performance Data on the Instructional Materials.

I. Anxiety Data

Effects of Response Modes on A-State For LA, MA, and HA Students

In order to investigate the relationships between levels of A-Trait and response modes on the seven A-State scores obtained during the experiment, the analyses were divided into three major periods. The first analysis focused on A-State measured before and after the pretest. The second analysis focused on A-State measured during the performance period, while the third analyzed A-State measured before and after the posttest. The cut-off scores for the LA and HA groups corresponded to the upper and lower quartiles of the published A-Trait norms for the college undergraduate females (Spielberger, et al., 1970).

The means and standard deviations of the seven A-State scores measured during the experiment for LA, MA, and HA students in the four response mode conditions are presented in Table 2. Three sets of three-factor analyses of variance with repeated measures on the last factor were calculated on this data. The independent variables in all three sets were levels of A-Trait (LA, MA, HA), response modes (R, C, MMC, CR), and the experimental time period in which A-State was measured.

Pretest A-State Analysis. The dependent variable in the first analysis was mean A-State scores before and after the pretest. Results of this analysis indicated that HA students had higher A-State scores ($\bar{X} = 12.04$) than either MA ($\bar{X} = 9.21$) or LA ($\bar{X} = 7.35$) students. This main effect of A-Trait was significant at the $p < .001$ level ($F = 30.64$, $df = 2/136$). Students were also found to have higher mean A-State scores during the pretest ($\bar{X} = 9.92$) than before the pretest ($\bar{X} = 8.93$) ($F = 19.82$, $df = 1/135$, $p < .001$). No other main effects or interactions were significant.

Performance Period. In order to evaluate changes in A-State during the CAI learning task, the second analysis of variance evaluated changes in A-State during the performance period. Results of the analysis of variance on these data revealed two significant interactions: 1) response mode conditions by periods ($F = 2.60$, $df = 6/272$, $p < .05$); 2) A-Trait by periods ($F = 2.22$, $df = 4/272$, $p < .05$). The interaction between response mode conditions and periods is shown in Figure 2, which indicates that students had differential increases in A-State scores during the Technical instructional materials with the CR and MMC groups showing the greatest increase, whereas the R group remained relatively the same. The C group was found to have a moderate increase in A-State scores during the Technical materials.

TABLE 2

Mean A-State Scores for LA, MA, and HA Students in

Response Mode Conditions During the Experiment

	Groups	Pretest Period Before	Pretest Period After	Performance Period Pre	Performance Period Familiar	Performance Period Technical	Posttest Period Before	Posttest Period After
	All groups (N=148)							
	Mean	8.93	9.92	10.16	9.20	10.63	9.69	11.11
	SD	3.40	3.68	3.28	3.01	4.09	4.17	4.76
READING	LA (n=11)							
	Mean	7.45	9.73	9.36	8.73	7.27	8.00	7.73
	SD	2.73	4.41	3.96	3.41	2.53	3.63	3.80
	MA (n=16)							
	Mean	8.88	9.19	8.63	8.31	8.63	8.31	9.94
	SD	4.24	3.12	3.26	3.40	3.01	3.14	4.45
	HA (n=10)							
	Mean	12.10	13.80	11.90	11.40	12.70	12.30	14.20
	SD	3.67	2.74	3.81	3.24	4.08	3.83	3.22
COVERT	LA (n=11)							
	Mean	7.45	7.00	7.36	7.18	7.91	7.73	8.18
	SD	3.11	1.73	2.11	1.89	3.42	3.44	2.93
	MA (n=16)							
	Mean	8.63	10.31	9.94	10.50	10.88	9.13	9.75
	SD	1.67	2.75	2.65	3.39	3.81	3.30	4.34
	HA (n=10)							
	Mean	10.40	12.60	11.80	10.20	11.80	9.60	10.80
	SD	2.80	3.66	13.46	1.93	3.58	2.55	4.98

TABLE 2--continued

	Groups	Pretest Period		Performance Period			Posttest Period	
		Before	AFter	Pre	Familiar	Technical	Before	After
MODIFIED MULTIPLE CHOICE	LA (n=11)							
	Mean	5.91	7.73	8.91	8.45	9.27	8.18	11.18
	SD	1.45	3.20	3.33	4.11	4.36	3.84	5.06
	MA (n=16)							
	Mean	8.50	9.06	10.31	7.81	10.81	8.81	11.19
	SD	2.71	2.91	2.91	3.54	4.37	3.37	3.60
	HA (n=10)							
	Mean	12.60	13.60	13.70	10.50	12.80	11.90	12.20
	SD	2.72	4.03	3.13	1.65	4.57	4.95	5.03
CONSTRUCTED RESPONSE	LA (n=11)							
	Mean	6.82	6.73	7.18	8.18	11.64	10.09	11.64
	SD	1.89	1.42	2.75	2.68	4.74	4.87	5.32
	MA (n=16)							
	Mean	9.13	10.00	11.13	10.56	12.75	11.75	13.87
	SD	3.83	2.80	4.10	3.72	4.61	4.28	4.77
	HA (n=10)							
	Mean	10.40	10.80	12.90	8.80	11.40	11.40	13.00
	SD	3.17	4.24	3.87	3.12	6.11	6.62	6.32

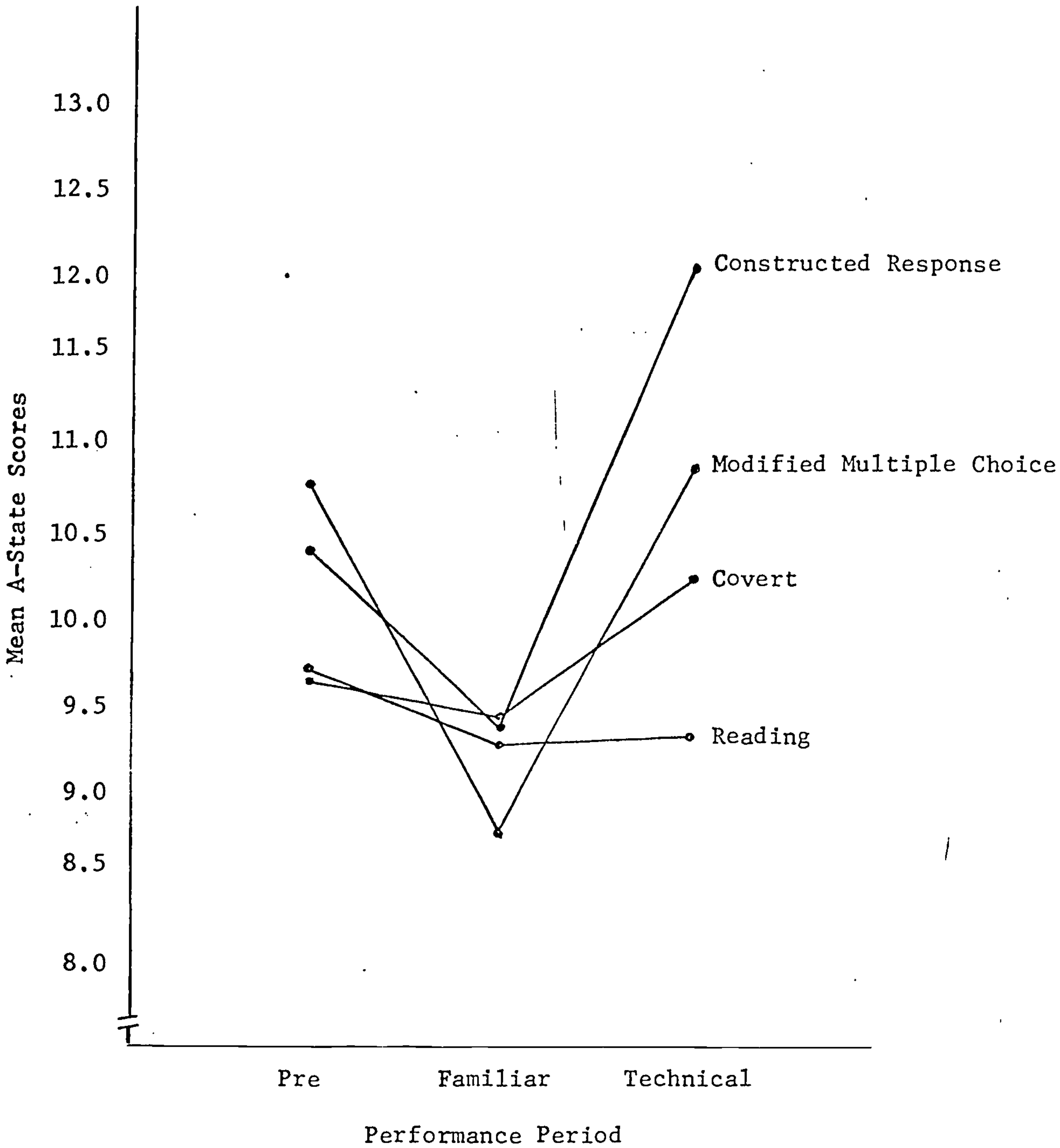


Figure 2. Mean A-State scores during performance period for students in the response mode condition.

A plot of the interaction between A-Trait level and periods is shown in Figure 3, which indicates that LA, MA, and HA students had differential changes in A-State scores across the three in-task periods. HA students were found to exhibit the most pronounced changes in A-State during the learning task, whereas LA students showed moderate increases in A-State on the Technical materials. For both the MA and HA students, there was a more pronounced decrease in A-State from the Pre to the Familiar measure and more of an increase from the Familiar to the Technical measure.

In general, throughout the performance period, HA students had higher A-State scores ($\bar{X}$ = 11.66) than either MA ($\bar{X}$ = 10.02) or LA ($\bar{X}$ = 8.45) students. This main effect of A-Trait was significant at the $p < .001$ level ($F = 13.08$, $df = 2/136$). In addition, students had higher A-State scores during the Technical materials ($\bar{X}$ = 10.63) and on the Pre measure ($\bar{X}$ = 10.16) than during the Familiar materials ($\bar{X}$ = 9.20). The periods main effect was significant at the $p < .001$ level ($F = 11.46$, $df = 2/272$).

Posttest A-State Analysis. The dependent variable in the third analysis of variance was mean A-State scores measured before and after the posttest. Results of this analysis revealed that HA students had higher A-State scores ($\bar{X}$ = 11.92) than MA ($\bar{X}$ = 10.34) or LA ($\bar{X}$ = 9.09) students ($F = 5.35$, $df = 2/136$, $p < .001$). The main effect of periods was again highly significant ($F = 28.87$, $df = 1/136$, $p < .001$), indicating that students had higher A-State scores during the posttest ($\bar{X}$ = 11.11) than before the posttest ($\bar{X}$ = 9.69). In addition, an important finding was that students in the CR group had higher A-State scores ($\bar{X}$ = 12.07) than students in the MMC ($\bar{X}$ = 10.46), C ($\bar{X}$ = 9.20), or R ($\bar{X}$ = 9.86) groups. This main effect of Response Modes was significant at the $p < .05$ level ($F = 3.53$, $df = 3/136$).

In summary, these three sets of A-State analyses revealed that students had higher levels of A-State during than before the pretest, as well as higher levels of A-State on the Technical CAI materials than on the Familiar CAI materials. Highest levels of A-State were evoked during the posttest for the students, whereas A-State levels were lower during the Familiar materials and before the achievement posttest. Students who were high in A-Trait were also found to respond to the learning task and achievement measures (pre- and posttests) with higher levels of A-State than low A-Trait students. A finding of particular interest was that students in the CR groups had the highest levels of A-State during the Technical learning materials and during the posttest.

II. Performance Data on Achievement Measures

Effects of Response Modes on Pretest Performance for LA, MA, and HA Students

The means and standard deviations of correct responses for LA, MA, and HA students in the four response modes on the pretest are shown in Table 3.

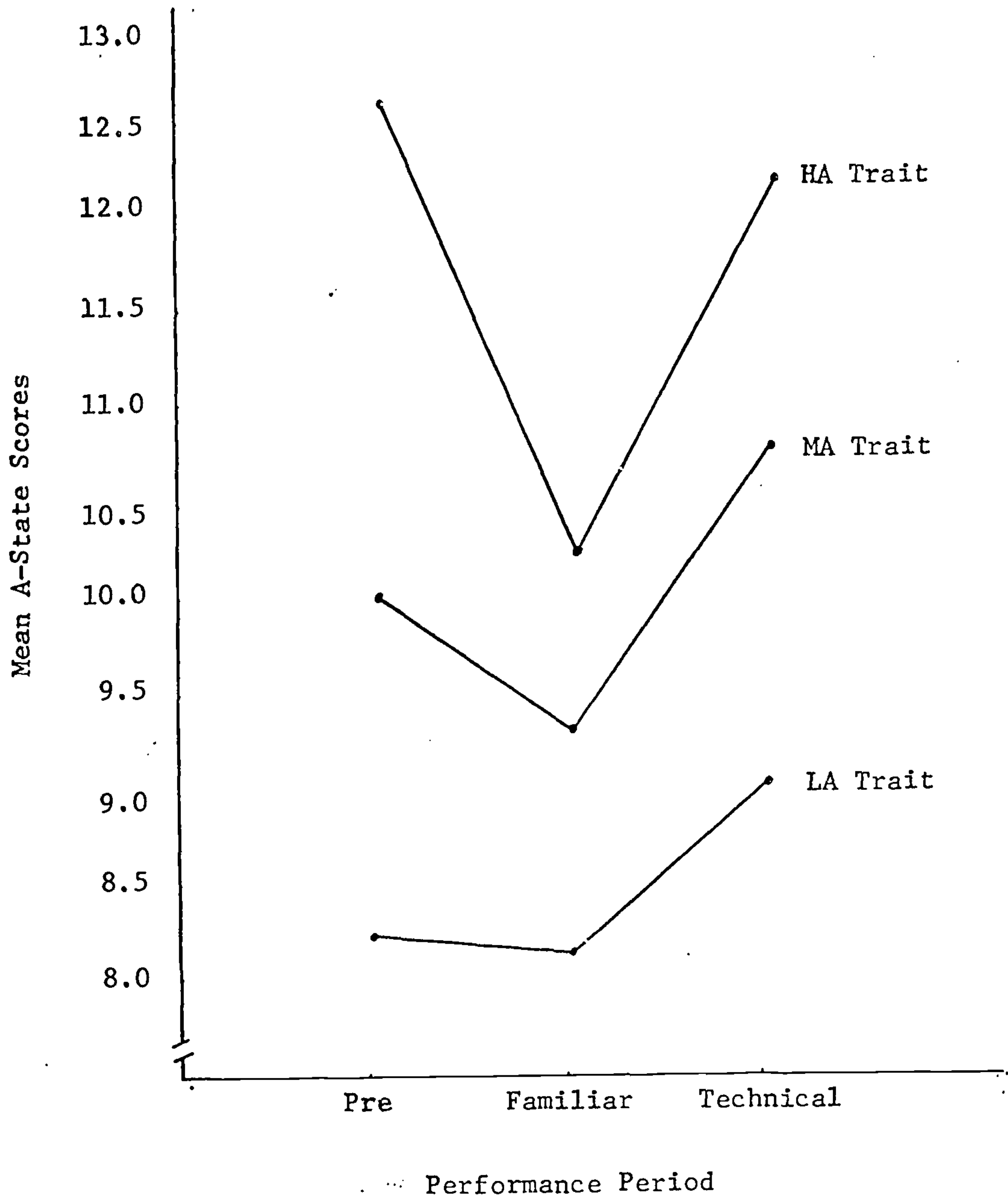


Figure 3. Mean A-State scores for LA, MA and HA students in the performance period.

Table 3
Mean Correct Responses on the Pretest for LA, MA, and HA Students in Response Mode Conditions

Groups	Low (LA)	A-TRAIT LEVEL Medium (MA)	High (HA)
Reading (N=37)			
Mean	6.18	8.38	6.80
SD	3.66	3.48	3.62
Covert (N=37)			
Mean	8.18	8.12	7.00
SD	4.42	3.48	4.03
Modified Multiple Choice (N=37)			
Mean	9.36	7.69	6.60
SD	3.11	3.70	2.50
Constructed Response (N=37)			
Mean	9.18	8.00	9.50
SD	3.66	3.01	3.89

To determine whether response modes and trait anxiety were related to student performance on the pretest, a two-factor analysis of variance was calculated. Independent variables in this analysis were levels of A-Trait (LA, MA, HA) and response modes (Reading, Covert, Modified Multiple Choice, Constructed Response). The dependent variable in this analysis was mean number of correct responses on the pretest. Results of the analysis of variance on these data revealed no significant main effects or interactions, indicating that the groups were well-matched on prior knowledge of the instructional materials.

Effects of Response Modes on Pretest Performance for Low, Medium, and High A-State Students

Also of interest in the present study was whether response modes and state anxiety were related to student performance on the pretest. The means and standard deviations of correct responses on the pretest for low, medium, and high A-State students in the four response modes are shown in Table 4.

The independent variables in this analysis were levels of A-State during the pretest (low, medium, high) and the four response modes. The students were divided into low, medium, and high A-State groups by ranking the distribution of A-State scores on the retrospective A-State measure given after the pretest and dividing this distribution into thirds. The R, C, MMC, and CR students were then separated out of this distribution

Table 4
Mean Correct Responses on the Pretest for Low, Medium, and High A-State Students in Response Mode Conditions

Groups	A-STATE LEVEL Low	Medium	High
Reading (n=37)			
Mean	8.10	6.86	7.05
SD	2.81	2.19	4.35
Covert (n=37)			
Mean	6.57	8.76	6.67
SD	3.82	3.95	3.39
Modified Multiple Choice (n=37)			
Mean	9.27	7.36	7.25
SD	3.35	3.75	2.60
Constructed Response (n=37)			
Mean	9.33	8.83	7.57
SD	2.77	3.52	4.35

yielding an unequal but proportional N in each group. The range of low A-State scores was 5-7; medium A-State scores ranged from 8-11; the range of high A-State scores was 12-20. The dependent variable in this analysis was mean number of correct responses on the pretest. As in the previous analysis, there were no significant main effects or interactions. Thus, these data indicate that neither level of state anxiety or response mode were related to pretest performance.

Effects of Response Modes on Posttest Performance for LA, MA, and HA Students

The means and standard deviations of correct responses on the Familiar and Technical portions of the posttest for LA, MA, and HA students in the four response mode conditions are presented in Table 5 and 6 respectively.

In order to examine the effects of response mode conditions and trait anxiety on Familiar and Technical posttest performance, a set of two, two-factor analyses of variance were calculated on these data. Independent variables in these analyses were levels of A-Trait (LA, MA, HA) and response mode conditions (R, C, MMC, CR). The dependent variable in the first analysis was mean correct responses on the Familiar portion of the posttest, while mean correct responses on the Technical posttest was the dependent variable on the second analysis.

Results of the analysis on the Familiar posttest indicated that level of A-Trait and response mode conditions differentially affected

TABLE 5

Mean Correct Responses on the Familiar Posttest for Low, Medium and High A-Trait Students in Response Mode Conditions

Groups	A-TRAIT LEVEL Low	Medium	High
Reading (N=37)			
Mean	17.73	16.83	15.90
SD	2.24	2.58	2.51
Covert (N=37)			
Mean	16.91	14.81	12.50
SD	2.95	3.58	4.03
Modified Multiple Choice (N=37)			
Mean	15.91	16.69	18.00
SD	2.77	4.54	1.89
Constructed Response (N=37)			
Mean	16.00	13.81	16.60
SD	3.58	3.54	6.60

TABLE 6

Mean Correct Responses on the Technical Posttest for Low, Medium and High A-Trait Students in Response Mode Conditions

Groups	A-TRAIT LEVEL Low	Medium	High
Reading (N=37)			
Mean	65.27	59.25	53.80
SD	15.46	18.27	13.77
Covert (N=37)			
Mean	59.73	52.25	40.80
SD	18.07	20.65	27.80
Modified Multiple Choice (N=37)			
Mean	58.00	45.50	47.40
SD	16.53	8.58	17.83
Constructed Response (N=37)			
Mean	66.09	57.06	60.40
SD	15.18	22.68	22.58

performance. This A-Trait by response mode interaction was significant at the $p < .05$ level ($F = 2.48$, $df = 6/136$. As is shown in Figure 4, there was little difference for LA Ss in the four response mode conditions. Moreover, either medium or high A-Trait students performed more poorly if they were in the R or C groups. The HA students performed better in the MMC and CR groups. In addition, students in the R and MMC groups had more correct response ($\bar{X} = 16.57$; $\bar{X} = 16.81$ respectively) than students in the CR ($\bar{X} = 15.26$) or C group ($\bar{X} = 14.81$). This main effect of response modes was significant ($F = 3.56$, $df = 3/136, p < .05$).

Results of the analysis on technical posttest performance indicated that LA students performed better ($\bar{X} = 62.27$) than MA ($\bar{X} = 53.52$) or HA ($\bar{X} = 50.60$) students on the Technical posttest. This main effect of A-Trait was significant at the $p < .05$ level ($F = 4.67$, $df = 2/136$). In addition, students in the CR ($\bar{X} = 60.65$) and R ($\bar{X} = 59.57$) groups performed better than students in C ($\bar{X} = 51.38$) and MMC ($\bar{X} = 49.73$) groups ($F = 3.28$, $df = 3/136$, $p < .05$). Both level of A-Trait and response mode conditions were, therefore, found to be related to Technical posttest performance.

Effects of Response Modes on Posttest Performance for Low, Medium, and High A-State Students

Since previous CAI research (O'Neil, Spielberger, & Hansen, 1969; O'Neil, Hansen, & Spielberger, 1969; O'Neil, 1970; Leherissey, O'Neil, & Hansen, In Press) have shown a relationship between A-State, rather than A-Trait and learning performance, this relationship was examined in the present study. The means and standard deviations of correct responses on the Familiar and Technical portions of the posttest for low, medium, and high A-State students in the four response mode conditions are presented in Table 7 and 8 respectively.

Two two-factor analyses of variance were calculated on these data. Independent variables in both analyses were levels of A-State during the posttest (low, medium, high) and response mode conditions (R, C, MMC, CR). Students were divided into low, medium, and high A-State groups by ranking the distribution of A-State scores on the retrospective A-State measure given after the posttest and dividing this distribution into thirds. The R, C, MMC, and CR students were then separated out of this distribution, yielding an unequal but proportional N in each group. The range of low A-State scores was 5-8; medium A-State scores ranged from 9-13; the range of high A-State scores was 13-20. The dependent variable in the first analysis was mean correct responses on the Familiar section of the posttest; mean correct responses on the Technical section of the posttest was the dependent variable in the second analysis.

Results of the analysis of variance on the Familiar posttest scores indicated that students in the R ($\bar{X} = 16.86$) and MMC ($\bar{X} = 16.81$) groups

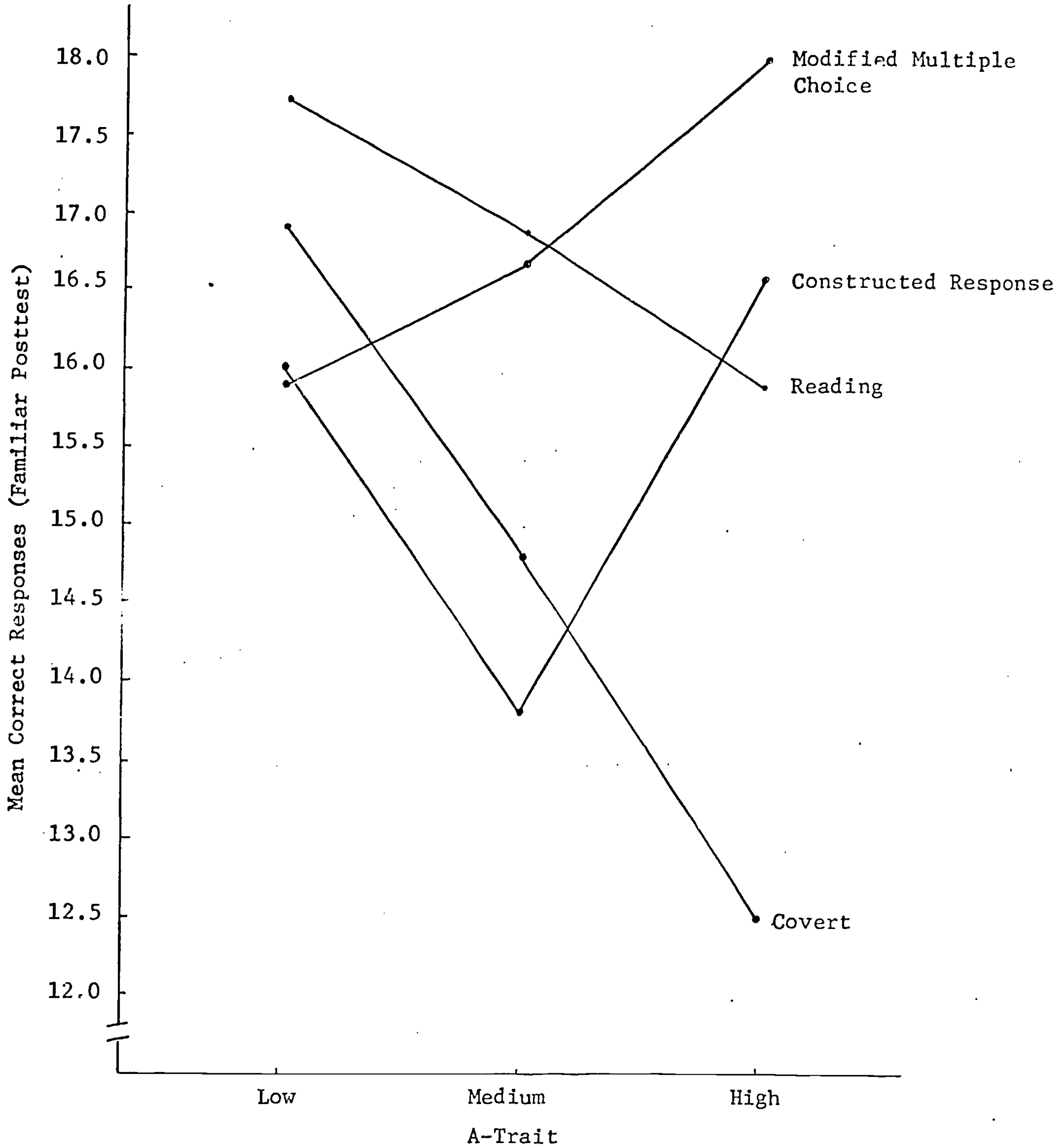


Figure 4. Mean correct responses on the F posttest for LA, MA and HA students in the response mode condition.

TABLE 7
Mean Correct Responses on the Familiar Posttest for Low, Medium, and High A-State Students in Response Mode Conditions

Groups	A-STATE LEVEL Low	Medium	High
Reading (N=37)			
Mean	17.33	16.83	16.20
SD	2.38	2.55	2.70
Covert (N=37)			
Mean	15.17	14.33	14.71
SD	4.12	3.45	4.75
Modified Multiple Choice (N=37)			
Mean	17.09	16.40	17.09
SD	2.70	3.72	4.13
Constructed Response (N=37)			
Mean	18.38	14.92	13.88
SD	3.16	3.52	3.28

TABLE 8
Mean Correct Responses on the Technical Posttest for Low, Medium, and High A-State Students in the Response Mode Conditions

Groups	A-STATE LEVEL Low	Medium	High
Reading (N=37)			
Mean	68.47	57.25	49.00
SD	16.45	12.52	14.58
Covert (N-37)			
Mean	52.56	50.42	50.00
SD	27.11	21.90	10.80
Modified Multiple Choice (N=37)			
Mean	50.27	52.67	45.18
SD	14.60	11.98	18.14
Constructed Response (N=37)			
Mean	70.00	57.38	58.63
SD	22.47	21.62	18.42

had higher scores than the CR ($\bar{X}$ = 15.22) and C ($\bar{X}$ = 14.81) groups. This main effect of Response Mode Conditions was significant at the $p < .05$ level ($F = 2.97$, df = 3/136).

Results of the analysis of variance on the mean correct responses on the Technical portion of the posttest also revealed a main effect of Response Mode Conditions ($F = 3.53$, df = 3/136, $p < .05$). Students in the CR ($\bar{X}$ = 60.65) and R ($\bar{X}$ = 59.57) groups had higher socres on the Technical posttest than the C ($\bar{X}$ = 51.38) and MMC ($\bar{X}$ = 49.73) groups. As in the preceding analysis, no other main effects or interactions were significant. However, the main effect of A-State did approach significance ($F = 2.98$, df = 2/136, $p < .10$), with low A-State students making more correct responses ($\bar{X}$ = 59.35) than medium ($\bar{X}$ = 54.39) or high ($\bar{X}$ = 51.71) A-State students.

III. Learning Time Data

Effects of Response Mode Conditions on Total Learning Time for LA, MA, and HA Students

The means and standard deviations for mean learning time of LA, MA, and HA students in the four response mode conditions are presented in Table 9.

Table 9
Mean Learning Times for Low, Medium, and High A-Trait Students in the Response Mode Conditions

	A-TRAIT LEVEL		
Groups	Low	Medium	High
Reading (n=37			
Mean	47.18	46.81	54.00
SD	18.69	16.74	30.94
Covert (n=37)			
Mean	67.91	68.81	58.90
SD	15.97	19.43	10.81
Modified Multiple Choice (n=37)			
Mean	104.73	104.38	101.60
SD	21.88	14.75	10.89
Constructed Response (n=37)			
Mean	100.73	113.69	120.30
SD	12.38	15.58	15.14

In order to determine whether students of different A-Trait levels in the four response mode conditions would differ in total time spent on the learning materials, a two-factor analysis of variance was calculated. The independent variables in this analysis were levels of A-Trait (LA, MA, HA) and response mode conditions (R, C, MMC, CR). The dependent variable in this analysis was mean number of minutes spent on the CAI learning task.

Results of the analysis of variance on these data indicated that students in the CR ($\bar{X}$ = 111.62) and MMC ($\bar{X}$ = 103.78) conditions took longer on the learning task than students in the R ($\bar{X}$ = 48.87) and C ($\bar{X}$ = 65.87) conditions. This main effect of Response Mode Condition was significant at the $p < .001$ level ($F = 103.33$, $df = 3/136$). Thus, level of A-Trait was not found to be related to total learning time, whereas there were significant differences in time spent on the learning task for students in the four response mode conditions.

Effects of Response Mode Conditions on Total Learning Time for Low, Medium, and High A-State Students

Another question of interest was the relationship between state anxiety, response mode conditions, and total time spent on the learning task. The means and standard deviations for mean learning times of low, medium, and high A-State students in the four response mode conditions are presented in Table 10.

Table 10
Mean Learning Times for Low, Medium, and High A-State Students in the Response Mode Conditions

Groups	Low	A-STATE LEVEL Medium	High
Reading (n=37)			
Mean	44.39	43.60	63.67
SD	15.76	8.46	33.91
Covert (n=37)			
Mean	65.25	66.81	65.00
SD	12.34	19.80	17.14
Modified Multiple Choice (n=37)			
Mean	102.92	103.80	104.57
SD	19.80	10.90	16.15
Constructed Response (n=37)			
Mean	101.67	109.00	117.15
SD	16.32	16.83	13.94

To examine this relationship, a two-factor analysis of variance was calculated. Independent variables in this analysis were levels of A-State during the Technical section of the learning materials (low, medium, high) and the four response mode conditions. The students were divided into low, medium, and high A-State groups by ranking the distribution of A-State scores during the Technical materials and dividing this distribution into thirds. The students in the R, C, MMC, and CR groups were then separated out of this distribution, yielding an unequal but proportional N in each group. The range of low A-State scores was 5-8; medium A-States scores ranged from 9-12; the range of high A-State scores was 13-20. Mean number of minutes spent on the CAI learning task was the dependent variable in this analysis.

Results of the analysis of variance on these data also indicated a significant main effect of Response Mode Conditions ($F = 91.52$, $df = 2/136$, $p < .001$). In addition, high A-State students ($\bar{X} = 97.35$) took longer on the task than either medium A-State students ($\bar{X} = 77.61$) or low A-State ($\bar{X} = 73.75$) students. This main effect of A-State was significant at the $p < .05$ level ($F = 3.46$, $df = 2/136$). Thus, level of A-State was found to be directly related to the amount of time spent on the learning task.

Although level of A-Trait was not related to total learning time, both level of A-State and Response Mode Conditions were related to time spent learning the instructional materials.

IV. Performance Data on Instructional Program

Effects of Response Modes on Learning Program Performance for LA, MA, and HA Students

Of interest in the present study was a comparison of the performance of students differing in level of A-Trait who responded to the learning materials (the MMC and CR groups) on the CAI learning task. It should be recalled that neither the R nor C groups were required to respond to these materials. The mean and standard deviations of correct responses on the Familiar and Technical materials for LA, MA, and HA students in the CR and MMC response mode conditions are presented in Tables 11, and 12, respectively.

Two two-factor analyses of variance were calculated on these data. The independent variables in both analyses were levels of A-Trait (LA, MA, HA) and response mode conditions (MMC, CR). The dependent variable in the first analysis was mean correct responses on the Familiar materials; mean correct responses on the Technical materials was the dependent variable in the second analysis.

Results of the analysis of variance on the Familiar materials revealed no significant main effects or interactions. The analysis of

TABLE 11
Mean Correct Responses on the Familiar Learning Materials for Low, Medium, and High A-Trait Students In Response Mode Conditions

Groups	Low	A-TRAIT LEVEL Medium	High
Modified Multiple Choice (n=37)			
Mean	67.36	67.25	65.00
SD	4.01	3.30	6.29
Constructed Response (n=37)			
Mean	66.82	67.19	67.80
SD	2.79	2.34	3.08

Table 12
Mean Correct Responses on the Technical Learning Materials for Low, Medium, and High A-Trait Students in the Response Mode Conditions

Groups	Low	A-TRAIT LEVEL Medium	High
Modified Multiple Choice (n-37)			
Mean	165.82	160.19	154.70
SD	9.65	16.13	26.93
Constructed Response (n=37)			
Mean	151.82	142.63	147.30
SD	19.93	24.86	16.04

variance on the Technical materials, however, yielded a main effect of response mode conditions ($F = 7.56$, $df = 1/68$, $p < .01$). Students in the MMC group made more correct responses ($\bar{X} = 160.38$) than the CR group ($X = 146.62$) on technical portion of the learning materials. Level of A-Trait was not found to be related to performance on the learning materials for the CR and MMC groups.

Effects of Response Modes on Learning Program Performance for Low, Medium, and High A-State Students

To test the assumption that state anxiety and response mode condition would be related to performance on the learning task, additional comparisons between the MMC and CR groups were made. The means and

standard deviations of correct responses on the Familiar and Technical learning materials for low, medium, and high A-State students in the two response mode conditions are presented in Tables 13 and 14, respectively.

Table 13
Mean Correct Responses on the Familiar Learning Materials
for Low, Medium, and High A-State Students
in the Response Mode Conditions

Groups	A-STATE LEVEL Low	Medium	High
Modified Multiple Choice (n=37)			
Mean	66.79	66.71	66.44
SD	3.09	6.26	3.24
Constructed Response (n=37)			
Mean	68.54	66.73	66.38
SD	1.71	2.97	2.79

Table 14
Mean Correct Responses on the Technical Learning Materials
for Low, Medium, and High A-State Students
in Response Mode Conditions

Groups	A-STATE LEVEL Low	Medium	High
Modified Multiple Choice (n=37)			
Mean	159.15	155.30	165.14
SD	17.93	26.24	10.23
Corrected Response (n=37)			
Mean	155.44	149.75	141.40
SD	22.97	18.29	20.82

Two two-factor analyses of variance were calculated on these data. Independent variables in both analyses were levels of A-State (low, medium, high) and response mode conditions (MMC, CR). The students were classified low, medium, and high A-State groups on the basis of their A-State scores during the Familiar materials for the first analysis; on the second analysis, students were classified low, medium, and high A-State groups on the basis of their A-State scores during the Technical materials. The

dependent measure in the first analysis was mean correct responses on the Familiar materials; mean correct responses on the Technical materials was the dependent measure in the second analysis.

Results of the analysis of variance on the Familiar materials again revealed no significant main effects or interactions. On the Technical materials, results of the analysis of variance indicated that students in the MMC group ($\bar{X} = 160.38$) made more correct responses than students in the CR groups ($\bar{X} = 146.62$). This main effect of response mode conditions was significant at the $p < .05$ level ($F = 5.29$, $df = 1/68$). As in the A-Trait analyses, level of A-State was not found to be related to performance on the learning materials for the CR and MMC groups.

Conclusions

The findings in the present study which were generally consistent with the predictions of Trait-State Anxiety Theory (Spielberger, Gorsuch, & Lushene, 1970) and Drive Theory (Spence, 1958; Taylor, 1956) may be summarized as follows: 1) students who were high in A-Trait responded to the learning task with higher levels of A-State than low A-Trait students; 2) higher levels of A-State were evoked by the more difficult Technical CAI materials than by the easy Familiar CAI materials. Thus, level of A-Trait was found to be related to level of A-State, and higher levels of A-State were associated with the difficult rather than easy sections of the learning materials.

Inconsistent with Trait-State Anxiety Theory and previous CAI studies with mathematical learning materials (Leherissey, O'Neil, & Hansen, In Press; O'Neil, Spielberger, & Hansen, 1969; O'Neil, Hansen, & Spielberger, 1969) was the finding that level of A-Trait was related to performance on the Technical posttest, i.e., low A-Trait students performed significantly better than high A-Trait students; whereas, level of A-State was only moderately related to Technical posttest performance ($p < .10$) with a tendency for low A-State students to perform better than high A-State students. The prediction and previous CAI finding that level of A-State rather than A-Trait was related to performance was, therefore, not replicated with the verbal and graphical learning materials used in the present CAI study.

Consistent with Tobias' findings (Tobias, 1968; Tobias, 1969; Tobias & Abramson, 1970), students were found to perform significantly better on the Familiar section of the achievement posttest than on the pretest. Tobias' finding, however, that the Constructed Response group achieved more than the Reading group on the Technical, but not Familiar, subject matter was not replicated in the present CAI study. In contrast, it was found that students in the Constructed Response and Reading groups performed at approximately the same level on the Technical portion of the achievement posttest. In addition, the present study found that students in the Covert and Modified Multiple Choice groups performed at approximately the same level, but significantly poorer than the Constructed Response and Reading groups on the Technical posttest.

In order to interpret the finding that the Constructed Response group did not achieve more than the Reading group on the Technical posttest, several other findings must be taken into consideration. First, it was found that students in the Constructed Response group had significantly higher A-State scores during the Technical portion of the learning program and before and during the achievement posttest than the Reading group. It would, therefore, appear that the Constructed Response mode may have been a more stressful condition than the Reading mode.

The second finding which seems to support this interpretation is that students in the Constructed Response group took nearly twice longer than the Reading group to learn the instructional materials. Furthermore, the present study found that level of A-State was related to learning time, in that high A-State students took longer on the learning task than medium or low A-State students. It thus seems reasonable to suggest that the average time of two hours on the CAI system for the Constructed Response group, associated with higher levels of state anxiety, may have served to depress their posttest performance.

Another possible explanation for the finding that the Constructed Response group did not perform better than the Reading group on the Technical posttest may be the fact that students in the Constructed Response group were made more hostile by the length of time required to learn the instructional materials. Written and verbal comments by students in the Constructed Response condition tend to support his explanation, and thus in Study II, hostility was measured. It must also be noted however, that the failure to replicate Tobias' (1968) findings may have been due to the fact that the type of practice in "constructing" EKG tracings for the CR group was not directly related to the actual drawing of tracings required on the achievement posttest.

Also of interest in the present study was a comparison of the relationships between response mode and performance for those students who responded to problems within the CAI learning materials. Neither level of A-Trait nor level of A-State was found to be related to performance on the Familiar and Technical portions of the learning program for students in the Constructed Response and Modified Multiple Choice groups. In addition, it was found that students in the Modified Multiple Choice group performed significantly better than students in the Constructed Response group on the Technical, but not Familiar, portion of the learning program.

The latter findings are not particularly surprising in light of the fact that the number of alternative responses for the Constructed Response group on the Technical graphical learning materials exceeded that of the Modified Multiple Choice group, and thus the probability of a greater percentage of errors for the Constructed Response group would be expected. In addition, a possible explanation for the failure to find a relationship between level of A-Trait or A-State and learning

program performance may be the fact that, unlike previous CAI studies (Leherissey, et al., In press; O'Neil, et al., 1969; O'Neil, et al., 1969b), students were not required to give the correct response before progresssing to the next frame. Thus, the present situation may have reduced the debilitating effects of anxiety on performance.

In conclusion, the findings of the present Study I make it difficult to evaluate the solute effects of response mode conditions on A-State and performance and point out the importance of taking into account both total time spent on the learning task and level of state anxiety in interpreting the results. Study II attempted to replicate and extend the findings of Study I.

Study II. Effect of Anxiety, Response Mode, Subject Matter Familiarity, and Learning Times on Achievement in Computer-Assisted Learning

In Study I, familiar and technical programmed instruction (PI) materials developed by Tobias (1968) were adapted for CAI presentation. Whereas Tobias found that a constructed response (CR) mode led to superior performance compared to a reading (R) mode on technical PI materials, Study I found no differences between CR and R groups presented the same materials via CAI.

The failure of Study I to replicate Tobias' (1968) findings may have been due to the fact that students in the CR group had significantly higher A-State during the technical materials and posttest than the R group. Although Tobias did not measure A-State, it was hypothesized that his CR group had comparable levels of A-State to his R group. In addition, the CR group took over twice as long to finish the CAI materials. Moreover, negative debriefing comments by the CR group indicated they may have been more hostile than the R group. Thus, the average time of two hours on the CAI task for the CR group, associated with higher state anxiety, and perhaps hostility, may have served to depress their posttest performance.

The present study sought to replicate the findings of the first study and also to reduce state anxiety and improve performance by shortening the amount of time spent on the instructional materials. Students were presented two forms of the verbal and graphical materials, R versions and CR versions. In addition, long and short versions of these materials were used. Hostility was measured to explicate and extend the previous findings.

The major predictions were: (1) students in the long CR version would have higher A-State than students in the long R version, whereas there would be no difference in the short versions; (2) the short CR group would make more correct responses on the technical posttest covering the short materials than the short R group, whereas there would be no difference in the long versions; (3) students in the long CR version would have higher hostility scores than students in the long R version, whereas there would be no difference in hostility scores in the short versions.

Methods

Subjects. 128 female undergraduate students enrolled in general psychology classes at Florida State University participated in the study. Ss were grouped on level of A-Trait, high (HA), medium (MA), and low (LA), and were randomly assigned to one of four experimental conditions, reading-long (R-L), reading-short (R-S), constructed-response long (CR-L), and constructed response short (CR-S). The Ss were run in small groups of 8 to 15 Ss; a total of 12 experimental sessions were required to run all groups of Ss. Each S participated in one session lasting from

approximately one to three hours. The distribution of A-Trait means and standard deviations across experimental conditions is presented in Table 15. It may be noted that LA, MA, and HA Ss across response modes and length conditions are well matched on A-Trait scores.

Table 15
Mean A-Trait Scores for LA, MA, and HA Students in Response Mode and Length Conditions

Groups	Low (LA)	A-Trait Level Medium (MA)	High (HA)
All groups (N=128)			
Mean	29.14	37.85	48.30
SD	3.33	2.55	5.35
Reading-Short (N=32)			
Mean	28.67	38.54	48.90
SD	3.67	2.40	4.20
Reading-Long (N=32)			
Mean	28.67	38.23	47.60
SD	3.94	2.42	5.87
Constructed Response-Short (N=32)			
Mean	29.44	37.69	48.40
SD	2.13	2.50	3.86
Constructed Response-Long (N=32)			
Mean	29.78	36.92	48.30
SD	3.73	2.87	7.47

Program Description and Achievement Measures. The R and CR instructional programs used in the first study were renamed Reading-Long (R-L) and Constructed Response-Long (CR-L). A complete description of these materials may be found in Study I, page 7. Two additional versions, Reading-Short (R-S) and Constructed Response-Short (CR-S), were prepared. These versions contained the same subject matter and frame structure as their longer counterparts, but terminated following the first two technical diagrammatic frames containing electrocardiogram (EKG) tracings.

The learning materials were divided into familiar (F), and initial technical (T_I), and remaining technical (T_R) sections. The pretest covered only the F materials. Ss in the short versions received the F and T_I materials and Ss in the long versions received the F, T_I and T_R materials. The pre and post achievement measures were the same as those

used in Study I, except the R-S and CR-S posttest contained only F and T_I items covered in the shortened versions of the instructional program.

Affective Measures. The State-Trait Anxiety Inventory (STAI) was used to measure both A-Trait and A-State in the same manner as described in Study I. The short-form A-State scales were given after the pretest via paper and pencil; immediately before the learning materials, immediately after the F, T_I and T_R materials via CAI; and after the posttest via paper and pencil.

The Multiple Affect Adjective Check List (MAACL) developed by Zucherman and Lubin (1965) was used to assess hostility toward the learning task. This measure is comprised of 132 adjectives keyed for three affects of anxiety, depression, and hostility. Individuals respond to the list by checking words which describe the way they felt while learning the instructional materials. For this study only the hostility scale (30 items) was scored.

Procedure. The experimental session was divided into three periods: 1) a pretask period during which Ss were administered the A-Trait scale, took the achievement pretest and its associated 5-item A-State scale, were assigned to treatment group and read instructions on the operation of the CAI terminal; 2) a Performance Period, during which Ss studied the familiar and either technical short or technical long CAI materials and took the short A-State scales; 3) a posttask period during which Ss were administered the MAACL scale, the achievement posttest, the final A-State scale and given a debriefing. These periods are further described below.

Pretask Period. Upon arrival at the CAI Center, Ss were administered the STAI A-Trait scale with standard instructions. This scale was collected and while being scored, Ss were given the pretest package containing the 17-item F pretest, and a short A-State scale to be completed following the pretest. The Ss were then assigned to one of the four treatment conditions based on their A-Trait scores: 1) R-S, 2) R-L, 3) CR-S, or 4) CR-L. The Ss then received written instructions on the operation of the CAI terminals.

Performance Period. All Ss were then seated at the CAI terminals and were informed that they would be receiving different versions of a program on heart disease and that Ss would, therefore, be finishing at different times. Ss were further instructed to come to the proctor's desk upon completion of the program to receive further directions.

After "signing on" the short form of the A-State scale was presented on the CRT with standard instructions. Next, depending upon the response mode condition to which Ss had been assigned, further instructions were given as to how to proceed through the learning materials. Specific instructions given to each of the treatment groups are as follows:

Reading: "You will not be required to supply an answer to any of the frames. Simply press the space bar to continue on to the next frame.

When you have finished the instructional material, you will be given a test on the material."

Constructed Response: "The material is presented in a series of frames, each of which requires you to give one or more answers. To answer each frame, you must type in the word or number that completes each blank and enter that response. On each frame of the material, when you have filled in all the blanks, the correct answer will appear on the screen before the next frame is presented. You will only be required to respond once to each frame, regardless of whether your answer is right or wrong. When you have finished the instructional materials, you will receive a test on the material." The CR group was then given practice in the operation of the keyboard and were instructed on the enter and erase functions.

All Ss were instructed to proceed through the learning materials at their own rate. Students in CR-S and R-S groups terminated shortly after beginning the technical diagrammatic frames containing EKG tracings whereas students in our long versions completed the materials. The CR groups were given a handout of 10 possible EKG tracing segments for the Technical Pictorial materials (T_P) and instructed to type in the combination of numbers from 0-9 which would complete a sample frame for this procedure (see Figure 1, Study I, p. 10). They then completed the following T_P materials in this manner.

During this performance period, all Ss were presented the short form of the A-State scale with retrospective state instructions immediately after the F materials and following the T_I materials. In addition, Ss on long versions responded to the A-State scale following the T_R section.

Posttask Period. After each S had completed the instructional program and last A-State scale, she "signed off" the CAI terminal and reported to the proctor where she received the MAACL and the posttest package containing the posttest (short or long form as appropriate), and a 5-item A-State scale to be completed following the posttest.

After the completion of the posttest package, Ss were informed that the task was quite difficult and were reassured that their performance had been satisfactory. The Ss were also given some additional information concerning the general nature of the experiment and requested not to discuss the experiment with their classmates.

Results

For the purpose of clarifying the presentation of the findings in the second study, the results will be reported in the same order as in the first study: 1) Anxiety Data During the Experimental Session; 2) Performance Data on Pre and Post Achievement Measures; 3) Learning Time Data During the Instructional Materials; and 4) Hostility Data on the Instructional Materials.

I. Anxiety Data

Effects of Response Modes and Length on A-State for LA, MA, and HA Students

In order to investigate the relationships between level of A-Trait, response modes and length on A-State scores obtained during the experiment, the analyses were divided into three major periods. The first analysis focused on A-State measured after the pretest; the second analysis focused on A-State measured during the performance period; and the third analyzed A-State measured after the posttest. The cut-off scores for the LA and HA groups corresponded to the upper and lower quantities of the published A-Trait norms for college undergraduate females (Spielberger, et al., 1970).

The means and standard deviations for the A-State scores measured during the experiment for LA, MA, and HA students in the response modes and length conditions are presented in Table 16. Since students in the short versions did not receive the Remaining Technical Materials (T_R), they did not receive the TR A-State scale. Four sets of three-factor analyses of variance were calculated on this data. The independent variables in the analyses were level of A-Trait (LA, MA, HA) response modes (R, CR), and length (short, long).

Pretest A-State Analysis. The dependent variable in the first analysis was the mean A-State scores measured following the pretest. Results of this analysis indicated that no main effects or interactions were significant. Thus, neither level of A-Trait, response modes, nor length affected pretest A-State levels.

Performance Period. In order to evaluate changes in A-State during the CAI learning task, two analyses of variance evaluated changes in A-State during the performance period. The first analysis of variance with repeated measures focused on A-State measured before the task, following the familiar materials, and following the initial technical materials. The second analysis of the variance focused on A-State at the completion of the task. The T_R measure was used as the final measure for the students in the long versions whereas the T_I A-State scale was used as the final measure for students in the short versions.

Results of the first analysis of variance indicated a significant response modes by periods interaction ($F = 8/02$, $df = 2/232$ $p < .001$). As is shown in Figure 5, the reading groups' A-State scores decreased from the Pre measure through the familiar materials and remained relatively constant during the initial technical materials. In contrast, the constructed response groups' A-State scores, although they decreased from the Pre measure to the familiar materials, increased during the initial technical materials. In addition, HA students had higher A-State scores ($\bar{X} = 11.06$) than either MA ($\bar{X} = 10.32$) or LA students ($\bar{X} = 8.53$). This main effect of A-Trait was significant at the $p < .001$ level ($F = 7.05$, $df = 2/116$). Moreover, A-State was highest initially

TABLE 16

Mean A-State Scores for LA, MA, and HA Students in Response

Mode and Length Conditions During the Experiment

	Groups	Pretest Period After	Pre	Performance Period Familiar	$Tech_I$	$Tech_R$	Posttest Period After
	All groups (N=128)						
	Mean	9.93	10.73	9.42	9.99	10.44	10.74
	SD	3.67	3.48	3.60	4.28	4.54	4.23
READING-LONG	LA (n=9)						
	Mean	9.11	8.22	7.22	6.56	7.89	8.33
	SD	4.19	2.82	2.22	2.65	4.31	4.06
	MA (n=13)						
	Mean	10.92	11.62	9.46	8.77	9.77	10.23
	SD	2.98	3.28	2.30	2.24	2.86	2.74
	HA (n=10)						
	Mean	9.80	11.40	9.60	10.20	9.80	9.80
	SD	3.26	3.57	3.63	5.12	3.99	3.26
READING-SHORT	LA (n=9)						
	Mean	8.11	8.89	8.56	7.00		7.44
	SD	3.76	3.14	3.43	2.83		3.25
	MA (n=13)						
	Mean	10.31	12.69	10.85	10.31		12.23
	SD	4.52	3.59	4.72	3.96		4.53
	HA (n=10)						
	Mean	10.00	11.70	9.60	10.40		9.50
	SD	3.62	3.40	3.34	3.95		3.34

TABLE 16-continued

	Groups	Pretest Period After	Performance Period Pre	Familiar	$Tech_I$	$Tech_R$	Posttest Period After
CONSTRUCTED RESPONSE-LONG	LA (n=9)						
	Mean	8.56	9.89	7.78	9.44	10.78	9.44
	SD	3.32	2.47	3.03	4.22	4.58	3.84
	MA (n=13)						
	Mean	9.92	9.46	8.92	9.62	10.15	11.77
	SD	3.35	3.62	3.71	4.59	4.68	4.97
	HA (n=10)						
	Mean	13.90	12.60	10.80	9.90	13.80	13.80
	SD	4.07	1.78	3.39	4.73	4.34	4.78
CONSTRUCTED RESPONSE-SHORT	LA (n=9)						
	Mean	9.78	9.89	8.22	10.67		9.67
	SD	3.07	4.34	2.28	4.00		3.77
	MA (n=13)						
	Mean	8.77	10.00	10.38	11.77		12.31
	SD	2.95	3.63	4.96	5.05		5.15
	HA (n=10)						
	Mean	9.50	11.50	10.50	14.50		12.50
	SD	3.17	3.41	3.72	3,21		2.64

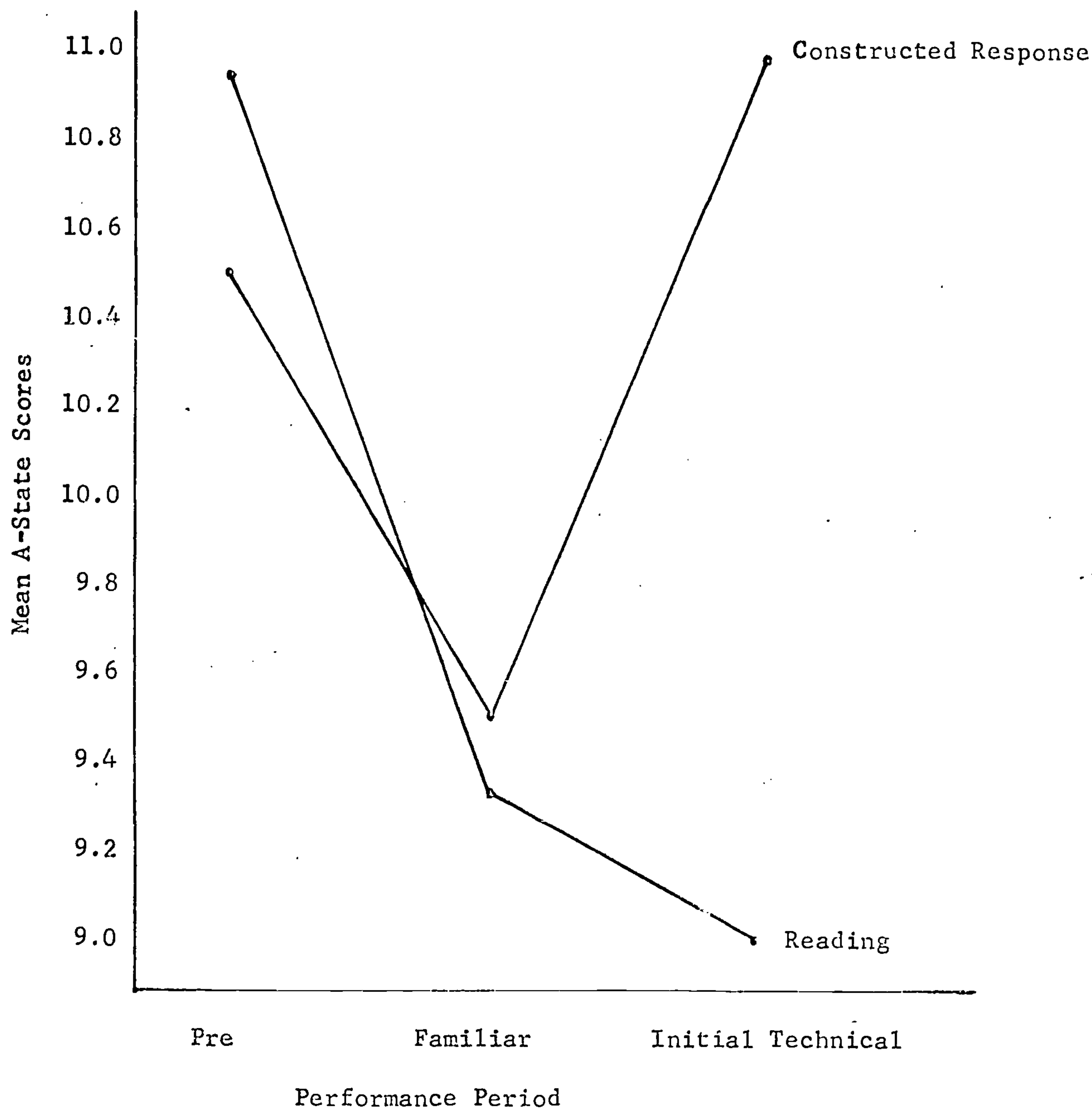


Figure 5. Mean A-State scores for students in the reading and constructed response versions in the performance period.

($\bar{X}$ = 10.73), decreased during the familiar materials ($\bar{X}$ = 9.42), and remained relatively the same during the initial technical materials ($\bar{X}$ = 9.99). This main effect of periods was significant at the $p < .001$ level ($F = 8.53$, df = 2/232).

There was no main effect nor interaction due to length. Since the length variable was not operationalized at this point, this ANOVA indicates that the length groups were well matched on A-State.

To directly test the impact of length, the second ANOVA in the performance period focused on A-State at the completion of the task. The results of this ANOVA indicated that HA students had higher A-State scores ($\bar{X}$ = 12.13) than either MA ($\bar{X}$ = 10.50) or LA students ($\bar{X}$ = 9.09). This main effect of A-Trait was significant at the $p < .01$ level ($F = 4.84$, df = 2/116). In addition, students in the constructed response group had higher A-State scores ($\bar{X}$ = 11.89) than students in the reading group ($\bar{X}$ = 9.33). This main effect of response modes was significant at the $p < 001$ level ($F = 12.97$, df = 1/116). No other main effects or interactions were significant.

Posttest A-State Analysis

The dependent variable in the fourth analysis of variance was mean A-State scores measured after the posttest. Results of the analysis revealed that HA students had higher A-State scores ($\bar{X}$ = 11.40) than either MA ($\bar{X}$ = 11.64) or LA ($\bar{X}$ = 8.72) students ($F = 6.39$, df = 2/166, $p < .005$). In addition, subjects in the constructed response groups had higher levels of A-State ($\bar{X}$ = 11.69) than subjects in the reading group ($\bar{X}$ = 9.80) groups. This main effect of response modes was significant at the $p < .01$ level ($F = 7.70$, df = 1/116). No other main effects or interactions were significant.

II. Performance Data on Achievement Measures

Effects of Response Modes and Length on Pretest Performance for LA, MA, and HA Students

The means and standard deviations of correct responses for LA, MA, and HA students in the response modes and length conditions on the pretest are shown in Table 17.

To determine whether trait anxiety, response modes, and length were related to student performance on the pretest, a three-factor analysis of variance was calculated. Independent variables in this analysis were level of A-Trait (LA, MA, HA), response modes (R, CR) and length (short, long). The dependent variable in this analysis was the number of correct responses on the pretest. In spite of randomization, results indicated that the reading group had fewer correct responses ($\bar{X}$ = 7.39) than the constructed response group ($\bar{X}$ = 8.28). This main effect approach significance ($F = 3.21$, df = 1/116, $p < .10$). Moreover, students assigned to the long versions had significantly higher pretest scores ($\bar{X}$ = 8.56) than subjects assigned to the short versions ($\bar{X}$ = 7.84). This main effect of length was significant at the $p < .01$ ($F = 7.69$, df - 1/116).

Table 17
Mean Correct Responses on the Pretest for LA, MA, and HA Students in Response Mode and Length Conditions

Groups	A-Trait Level Low (LA)	Medium (MA)	High (HA)
All groups (N=128)			
Mean	7.89	7.83	7.80
SD	3.13	3.09	2.41
Reading-Long Mean (N=32)			
Mean	7.56	9.00	8.20
SD	2.30	2.35	2.53
Reading Short Mean (N=32)			
Mean	6.67	5.46	7.50
SD	3.16	3.71	2.22
Constructed Response-Long (N=32)			
Mean	10.00	9.07	7.30
SD	4.06	2.36	2.58
Constructed Response-Short (N=32)			
Mean	7.33	7.77	8.20
SD	2.00	2.52	2.53

Effects of Response Modes and Length on Pretest Performance for Low, Medium, and High A-State Students

Also of interest in the present study was whether state anxiety, response modes, and length were related to student performance on the pretest. The means and standard deviations of correct responses on the pretest for low, medium, and high A-State students in the response modes and length conditions are shown in Table 18.

The independent variables for this analysis were level of A-State during the pretest (low, medium, high), response modes (R, CR), and length (short, long). The students were divided into low, medium, and high A-State groups by ranking the distribution of A-State scores on the the retrospective A-State measure given after the pretest and dividing this distribution into thirds. The range of low A-State scores was 5-7; medium A-State scores ranged from 8-11; the range of high A-State scores was 12-20. The dependent variable in this analysis was mean number of correct responses on the pretest. As in the previous analysis, the results indicated, in spite of randomization, that students in the reading

Table 18
Mean Correct Responses on the Pretest for Low, Medium, and High A-State Students in the Response Mode and Length Conditions

Groups	A-STATE LEVEL Low	Medium	High
Reading Long (N=32)			
Mean	6.71	9.00	8.50
SD	2.43	2.33	2.12
Reading Short (N=32)			
Mean	5.64	7.30	6.13
SD	2.20	2.95	4.52
Constructed Response Long (N=32)			
Mean	10.00	8.14	8.82
SD	5.20	1.51	2.96
Constructed Response Short (N=32)			
Mean	7.75	7.45	8.22
SD	2.10	2.91	2.05

groups had fewer correct responses on the pretest ($\bar{X} = 7.39$) than students in the CR group ($\bar{X} = 8.28$). This main effect of response modes was significant at the $p < .01$ level ($F = 5.49$, $df = 1/116$). Further, students in the short version had fewer correct response ($\bar{X} = 7.11$), than students in the long version ($\bar{X} = 8.44$). This main effect of length was significant at the $p < .01$ level ($F = 8.19$, $df = 1/116$).

Effects of Response Modes and Length on Posttest Performance for LA, MA, and HA Students

The means and standard deviations of correct responses on the familiar, initial technical, and remaining technical portions for the posttest for LA, MA, and HA students in the response modes and length conditions are presented in Table 19, 20, 21 respectively.

In order to examine the effects of response modes, length and A-Trait on familiar and initial technical, and technical posttest performance, a set of three-factor analyses of variance were calculated for these data. Independent variables in the first two analyses were the level of A-Trait (LA, MA, HA) response mode conditions (R, CR) and length (short, long). The dependent variable of the first analysis was the mean correct responses of the familiar portion of the posttest, while mean correct responses on the initial technical posttest was the dependent variable in the second analysis. Finally, a third ANOVA was calculated on the mean

Table 19
Mean Correct Responses on the Familiar Posttest for Low, Medium, and High A-Trait Students in the Response Mode and Length Conditions

Groups	A-Trait Levels Low	Medium	High
Reading Long (n=32)			
Mean	16.11	16.92	17.60
SD	2.57	2.33	3.06
Reading Short (n=32)			
Mean	18.11	15.46	17.20
SD	3.10	3.93	2.66
Constructed Response-Long (n=32)			
Mean	15.56	12.62	12.20
SD	2.92	2.40	2.20
Constructed Response-Short (n=32)			
Mean	15.33	15.15	17.20
SD	3.77	2.67	3.39

Table 20
Mean Correct Responses on the Initial Technical Posttest for Low, Medium, and High A-Trait Students in Response Mode and Length Conditions

Groups	A-Trait Level Low	Medium	High
Reading Long (n=32)			
Mean	14.78	18.23	18.00
SD	4.82	3.92	5.21
Reading Short (n=32)			
Mean	18.44	13.08	18.20
SD	3.54	6.30	6.07
Constructed Response-Long (n=32)			
Mean	20.22	19.00	18.40
SD	2.59	3.19	3.84
Constructed Response-Short (n=32)			
Mean	20.78	19.46	19.80
SD	5.52	4.01	5.07

Table 21
Mean Correct Responses on the Remaining Technical Posttest
for Low, Medium, and High A-Trait Students
in Response Mode and Length Conditions

Groups	A-Trait Level Low	Medium	High
Reading Long (n=32)			
Mean	31.33	32.15	31.30
SD	19.27	18.76	12.75
Constructed Response-Long (n=32)			
Mean	33.44	28.31	33.60
SD	13.86	17.79	21.38

correct responses on the remaining technical posttest. In this ANOVA, the independent variables were level of A-Trait (LA, MA, HA) and response mode conditions (R, CR).

Results of analysis of variance on the familiar posttest indicated that level of A-Trait, response modes, and length differentially affected responding on the familiar posttest. This triple interaction was significant at the $p < .05$ level ($F = 4.48$, df = 2/116). As shown in Figure 6, for low A-Trait subjects, those in the reading-short group had better performance on the F posttest than either of the other groups, whereas for middle A-Trait subjects, those in the reading long group performed better than either subjects in the constructed response-short or the reading-short groups, with the poorest performance of MA Ss in the constructed response long group. For high trait subjects in the constructed response groups, their performance was much poorer than any of the three other groups. In addition, the response mode by length interaction was significant ($F = 5.13$, df = 1/116). As is shown in Figure 7, it was indicated that whereas there was little difference in the reading group in the long and short versions, Ss in the shorter version of the CR materials performed significantly better than the F posttest Ss in the long version of the CR materials. The performance of the CR-$\bar{S}$ group was approximately the same as the R group. Furthermore, students in the constructive response version had fewer correct responses ($\bar{X} = 14.57$) than students in the reading group ($\bar{X} = 16.83$). This main effect of response modes was significant at the $p < .001$ level ($F = 17.73$, df = 1/116).

Given that the pretest scores were affected by response mode and length, the above data were reanalyzed using the pretest as a covariate on the F posttest scores. The results of this ANOCOVA yielded the same statistical conclusions as the above ANOVA.

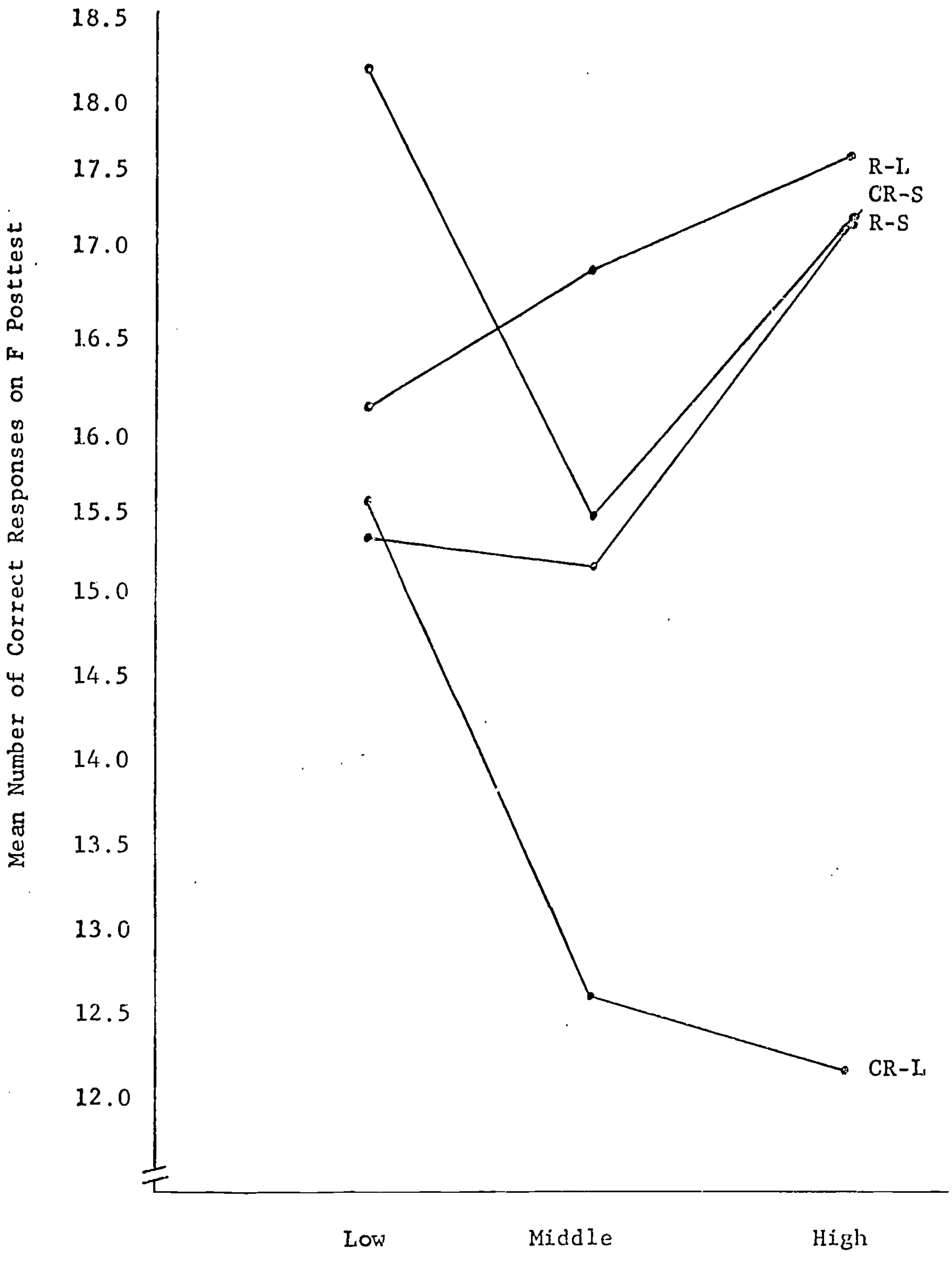


Figure 6. Mean number of correct responses on F posttest for LA, MA, and HA students in the response mode and length conditions.

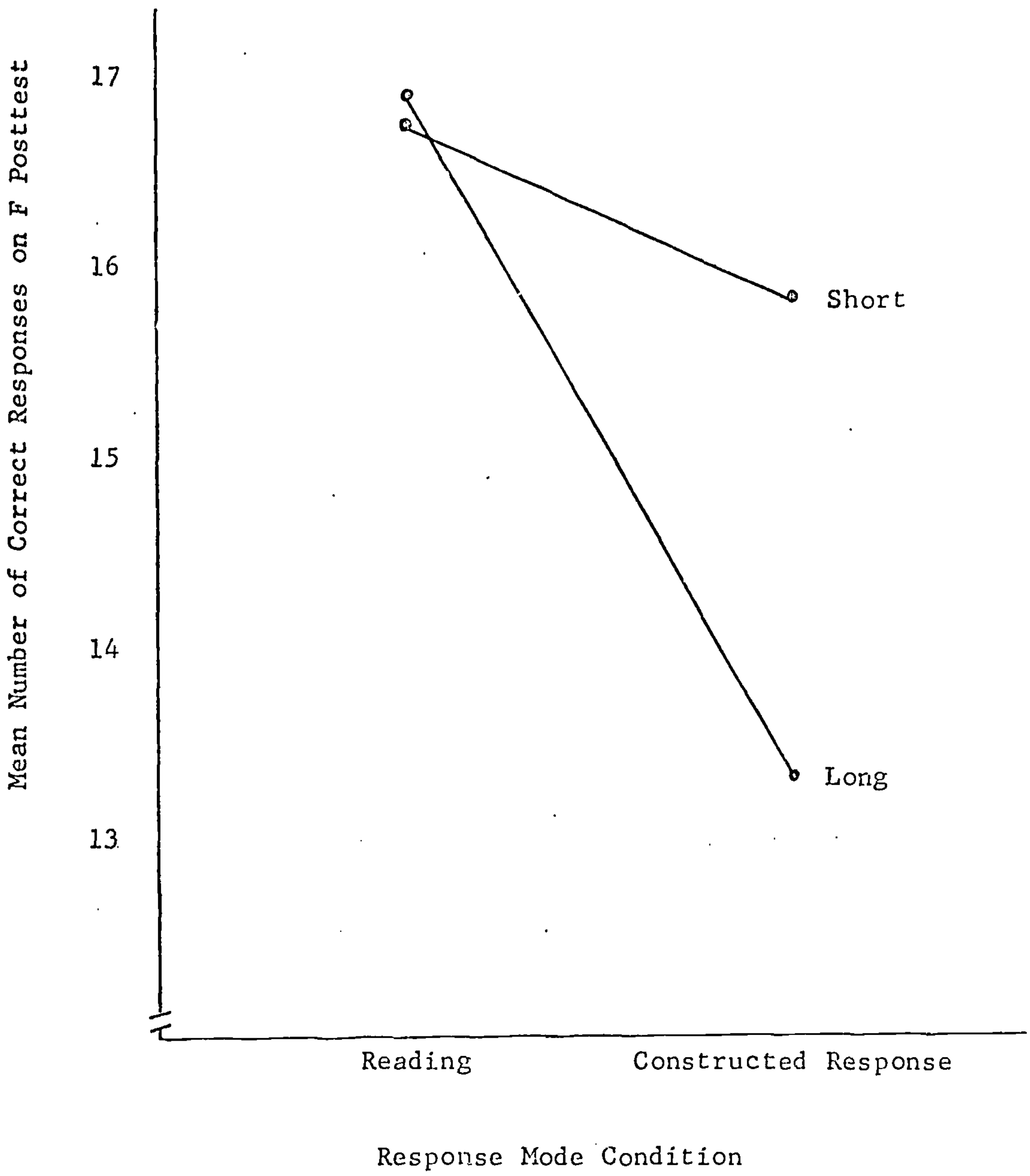


Figure 7. Mean number of correct responses on F posttest for students in the response mode and length conditions.

Results of the analyses on the initial technical posttest indicated that subjects in the constructed response group had more correct responses ($\bar{X}$ = 19.55) than subjects in the reading group ($\bar{X}$ = 16.83). This main effect of response mode was significant at the $p < .001$ level ($F = 11.55$, $df = 1/116$). No other main effects or interactions were significant.

The effect of A-Trait and response modes was investigated on the remaining technical posttest. The reader may note that since subjects in the short versions did not receive the remaining technical learning materials, they therefore did not receive the remaining technical portion of the posttest. The results of the analysis of variance on a technical posttest revealed that no main effects or interactions were significant, indicating that neither level of A-Trait nor response mode effected remaining posttest performance.

Effects of Response Modes and Length on Posttest Performance for Low, Medium, and High A-State Students

Since low A-State students in Study I made more correct responses than either medium or high A-State students on the posttest, this relationship was examined in the present study. The means and standard deviations for correct responses on the familiar and initial technical portions for the posttest for low, medium, and high A-State students in the response modes and length conditions are presented in Tables 22, and 23 respectively. Table 24 represents the means and standard deviations on the remaining technical posttest for low, medium, and high A-State students in the CR-L and R-L groups.

Table 22
Mean Correct Responses on the Familiar Posttest for Low, Medium, and High A-State Students in Response Mode and Length Conditions

Groups	A-State Level Low	Medium	High
All groups (N=128)			
Mean	16.99	16.40	13.74
SD	2.78	3.07	3.27
Reading-Long (N=32)			
Mean	16.71	17.82	15.86
SD	2.67	2.71	2.19
Reading-Short (N=32)			
Mean	18.75	16.91	13.89
SD	2.09	2.70	3.92
Constructed Response-Long (N=32)			
Mean	15.50	13.67	11.93
SD	2.83	2.87	1.98
Constructed Response-Short (N=32)			
Mean	16.38	16.67	14.67
SD	2.92	2.87	3.73

Table 23
Mean Correct Responses on the Initial Technical Posttest
for Low, Medium, and High A-State Students
in Response Mode and Length Conditions

Groups	A-State Level Low	Medium	High
All groups (N=128)			
Mean	18.31	19.65	16.39
SD	5.11	3.14	5.73
Reading-Long (N-32)			
Mean	16.07	19.00	16.57
SD	5.50	3.41	4.50
Reading-Short (N=32)			
Mean	17.42	19.00	11.11
SD	4.96	3.52	6.97
Constructed Response-Long (N=32)			
Mean	20.75	18.78	18.53
SD	3.50	2.73	3.29
Constructed Response-Short (N=32)			
Mean	21.13	21.50	17.58
SD	4.32	2.28	5.90

Table 24
Mean Correct Responses on Remaining Technical Posttest
for Low, Medium, and High A-State Students
in Long Response Mode Conditions

Groups	A-State Levels Low	Medium	High
All groups (N=64)			
Mean	37.23	28.40	28.68
SD	16.54	15.69	18.00
Reading-Long (N=32)			
Mean	33.93	31.46	27.43
SD	16.46	17.61	17.51
Constructed Response-Long (N=32)			
Mean	43.00	24.67	29.27
SD	16.05	12.99	18.81

Two three-factor analyses of variance were calculated on the familiar and initial technical posttest. Independent variables for these analyses were level of A-Statduring the posttest (low, medium, and high), response mode conditions, (R, CR), and length (short, long). In the final analysis for the remaining technical materials the independent variables were level of A-State during the posttest (low, medium, and high), and response modes conditions (R, CR). Students were divided into low, medium, and high A-State groups by ranking the distribution of A-State scores on the retrospective A-State measure given after the posttest and dividing this distribution into thirds. The range of low A-State scores was 5-8; medium A-State scores ranged from 9-12; the range of high A-State scores was 13-20. The reader may note that the students in the short versions did not receive the remaining tejhnical materials and thus did not receive the T_R posttest.

The results of the analysis of variance on the familiar posttest scores indicated that there was a significant A-State by response mode and by length interaction ($F = 3.18$, $df = 2/116$, $p < .05$). As is shown in Figure 8, increasing levels of A-State were debilitating on F posttest performance. Moreover, the CR-L group performed consistently poorer than the other treatment groups. Further, while the R-S condition resulted in the best performance for low A-State students, this condition for high A-State students was debilitating. For the R-L group, their performance was relatively consistent for all levels of A-State.

Results of the ANOVA on the T_I posttest indicated a significant A-State by length interaction ($F = 3.21$, $df = 2/116$, $p < .05$). As is shown in Figure 9, the students in the long versions performed relatively the same, independent of A-State level. In contrast, in the short versions, medium A-State students performed better than either low or high A-State students. Further, the main effect of Response Modes was significant at the $p < .001$ level ($F = 15.65$, $df = 1/116$) with the Constructed Response groups scoring higher ($\bar{X} = 19.55$) than the Reading groups ($\bar{X} = 16.69$). It was also shown that A-State was a significant factor effecting performance on the T_I posttest ($F = 7.5$, $df = 2/116$, $p < .001$), as medium A-State students scored higher ($\bar{X} = 19.65$) than either high ($\bar{X} = 16.30$) or low ($\bar{X} = 18.31$) A-State students.

The results of the analysis on A-State and Response Mode on the technical-remaining posttest indicated that no main effects or interactions were significant. Neither level of A-State nor Response mode effected students' T_R posttest scores.

III. Learning Time Data

Effects of Response Modes and Length on Learning Time Data for LA, MA, and HA Students

The means and standard deviations for mean learning times of LA, MA, and HA students in the response mode and length conditions are presented in Table 25.

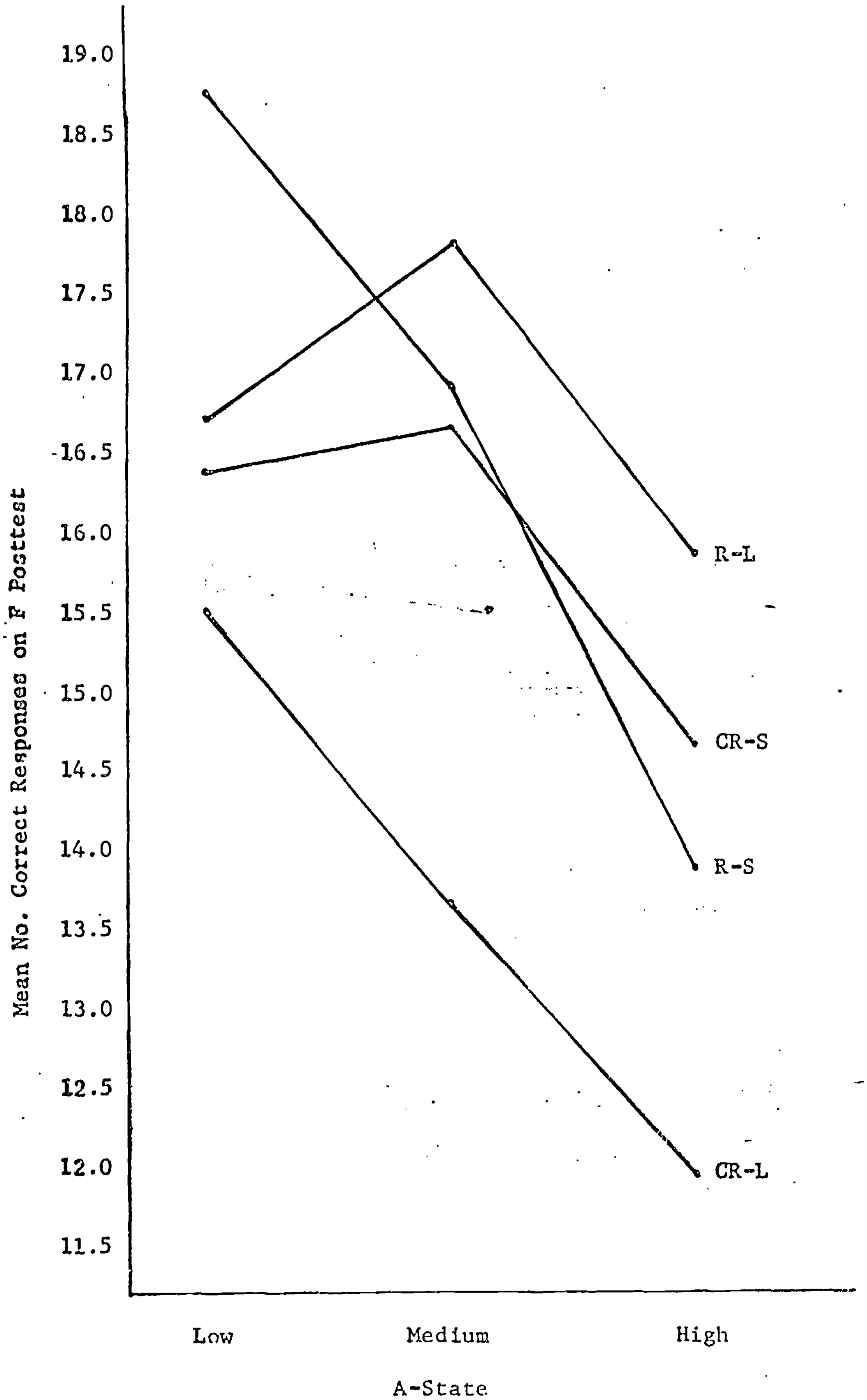


Figure 8. Mean number of correct responses on the F posttest for low, medium, and high A-State students in the response mode and length conditions.

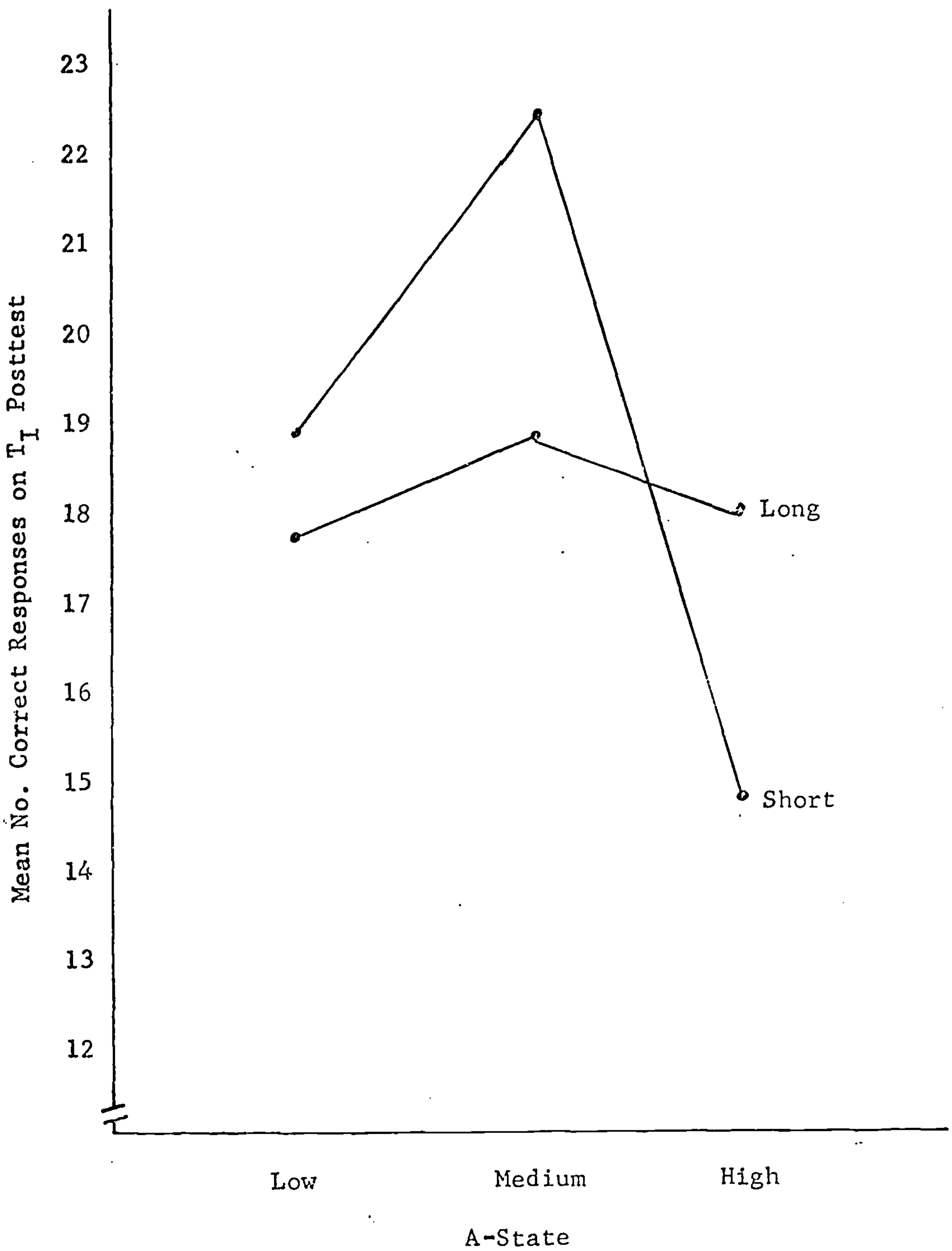


Figure 9. Mean number of correct responses on the T_I posttest for low, medium, and high A-State students in the length conditions.

Table 25
Mean Learning Times of Low, Medium, and High A-Trait Students in Response Mode and Length Conditions

Groups	A-Trait Level Low	Medium	High
Reading-Long (N=32)			
Mean	49.00	45.46	44.30
SD	22.63	8.22	9.71
Reading-Short (N=32)			
Mean	25.00	26.23	29.20
SD	2.40	5.88	6.39
Constructed Response-Long			
(N=32) Mean	120.33	122.85	120.10
SD	29.42	18.23	22.13
Constructed Response-Short			
(N=32) Mean	65.89	65.08	68.60
SD	10.60	17.07	6.31

In order to determine whether students of different A-Trait levels in the response mode and length conditions would differ on total time spent on learning materials, a three-factor analysis of variance was calculated. Independent variables in this analysis were level of A-Trait (LA, MA, HA) response mode conditions (R, CR), and length (short, long). The dependent variable in this analysis was mean number of minutes spent on the learning task.

Results of the analysis of the variance of these data indicated a length by response mode interaction ($F = 41.95$, $df = 1/116$, $p < .001$), which indicated as is shown in Figure 10 that there was little difference in total time for Ss in the reading group as a function of length. For Ss in the constructed response group length was a determining factor in total time. In addition, the main effect of response mode was significant ($F = 446.10$, $df = 1/116$, $p < .001$), indicating that subjects in the reading group spent significantly less time ($\bar{X} = 46.09$) than subjects in the constructive response group ($\bar{X} = 121.25$). In addition, subjects in the short version spent significantly less time ($\bar{X} = 46.61$) than subjects in the long version ($\bar{X} = 83.67$). This main effect of length was significant at $p < .001$ ($F = 186.24$, $df = 1/116$).

IV. Hostility Data on Experimental Session

Effects of Response Modes and Length on Hostility Scores for LA, MA, and HA Students

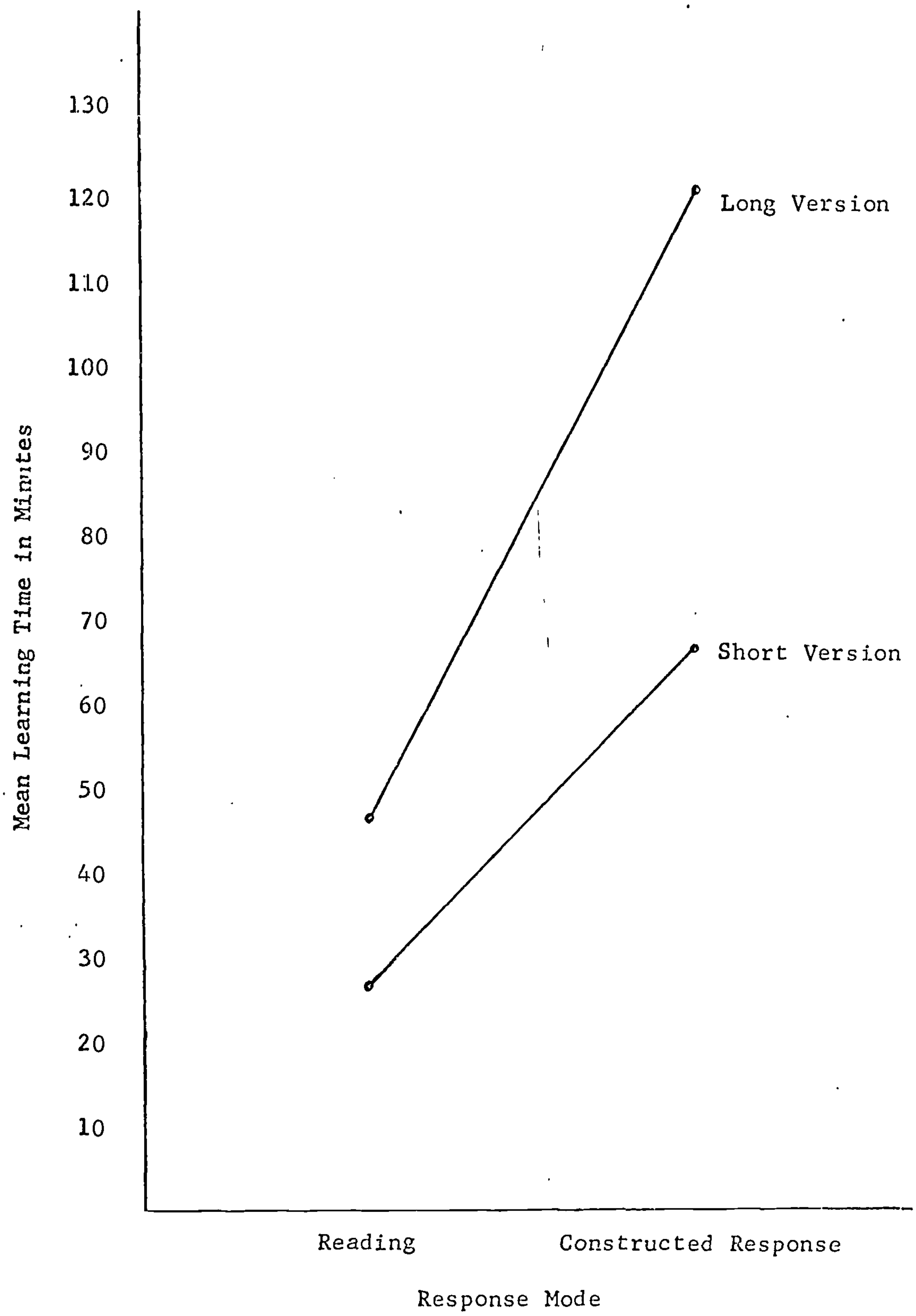


Figure 10. Mean learning times for students in the response mode and length conditions.

The means and standard deviations of hostility scores for LA, MA, and HA students in the response mode and length conditions are presented in Table 26.

Table 26
Hostility Scores for Low, Medium, and High A-Trait Students in Response Mode and Length Conditions

Groups		A-Trait Level	
	Low	Medium	High
Reading-Long (N=32)			
Mean	10.44	10.92	10.70
SD	2.35	3.62	3.89
Reading-Short (N=32)			
Mean	9.56	11.85	10.30
SD	2.74	4.91	1.06
Constructed Response-Long (N=32)			
Mean	13.00	13.73	13.10
SD	2.40	2.62	1.29
Constructed Response-Short (N=32)			
Mean	12.22	11.69	13.60
SD	2.39	3.57	4.17

In order to investigate the relationship between A-Trait, response modes, and length on total MAACL hostility scores, an analysis of variance was calculated in which level of A-Trait (LA, MA, and HA) response modes (R, CR), and length (short, long) were the independent variables. This analysis revealed that the constructed response groups had higher hostility scores ($\bar{X}$ = 12.78) than the reading group ($\bar{X}$ = 10.72). This main effect of response modes was significant at the $p < .001$ level ($F = 14.40$, df = 1/116). No other main effects nor interactions were significant, indicating that neither A-Trait nor program length differentially effected hostility levels.

Conclusions

The purpose of the present study was to replicate the major findings of Study I and, in addition, to explicate and extend these findings. Specifically, Study II sought to reduce state anxiety and improve performance by shortening the amount of time students spent on the instructional materials. Thus, the findings of the present study will

be summarized in the order of 1) the replicable findings of Studies I and II; 2) the effects of reducing program length on state anxiety; and 3) the effects of shortening program length on performance. In addition, the effects of hostility, as measured by the Multiple Affect Adjective Check List (Zuckerman & Lubin, 1965) will be discussed.

The findings of Study II which replicated those of Study I include the finding that, in general, high A-Trait students had higher levels of A-State throughout the experimental task than either medium or low A-Trait students, thus supporting Trait-State Anxiety Theory predictions. In addition, the A-State analyses of both Studies I and II indicated that A-State scores decreased for both the reading and constructed response groups from the Pre to Familiar measures, remained relatively constant for the reading group following the Technical materials, but increased for the constructed response group on the Technical A-State measure. Further, students in the constructed response groups were found to have higher levels of A-State during the posttest than students in the reading groups in both Studies I and II.

Regarding the replicated performance results, neither level of A-Trait nor level of A-State affected student performance on the pretest. Results of posttest performance in Studies I and II indicated that students in the reading groups performed better than students in the constructed response groups on the familiar portion of the posttest. With respect to the total time required to learn the instructional materials, subjects in the constructed response groups, in general, took approximately twice as long to learn the instructional materials as subjects in the reading groups.

Although it was hypothesized that shortening program length would lead to reductions in level of A-State, particularly for those students in the constructed response short version, this hypothesis was not supported in Study II.

It was further hypothesized that shortening program length would improve the posttest performance of students in the constructed response short group relative to the performance of students in the reading short group. Relevant to this hypothesis was the finding that students in the shortened program versions performed significantly better than students in the longer versions on the familiar posttest. Moreover, the significant interaction between response modes and program length on the familiar posttest indicated that whereas there was little difference in the performance of students in the long and short reading groups, students in the short constructed response version performed significantly better than students in the long constructed response version.

In addition, there was a significant interaction between level of A-State, response modes, and program length on the familiar portion of the posttest which indicated that level of A-State was not as debilitating to the performance of students in the short constructed response version

relative to the performance of students in the long constructed response version. That is, medium and high A-State students in the short constructed response version performed at approximately the same level as students in the reading versions, whereas for students in the long constructed response version, level of A-State was particularly debilitating to the performance of medium and high A-State students. This interaction thus provides some indirect evidence of the differential effects of A-State for students in the short and long program versions.

An analysis of the performance of students on the initial technical posttest failed to support this hypothesis that shortening instruction time would improve performance. Thus, shortening program length was only partially effective in improving the performance of students on the posttest.

With respect to the hostility findings, it was found, as predicted, that students in the constructed response groups had higher hostility scores than students in the reading groups. Contrary to predictions, however, shortening program length did not effect the hostility scores of students, i.e., students in the long and short program versions did not differ in mean hostility engendered by the learning task.

With respect to the A-State findings in Study II which did not replicate those of Study I, it should be noted that the performance of A-State measures used in Study I and II were not directly comparable. Students in the long versions were not directly comparable, in that students in the long versions of Study II were responding to only the remaining technical materials on the final in-task A-State measure. Whereas in Study I, they were instructed to give an anxiety rating on the entire technical task (T_I, T_R). Thus, the failure to replicate some of the A-State findings may have been due in part to this methodological factor.

With respect to performance results in Studies I and II, several findings failed to replicate. First, the interactions involving A-Trait level and response modes on the F posttest were in the opposite directions. That is, in Study I whereas high A-Trait students in the constructed response group performed better than low A-Trait students, and low A-Trait students in the reading group performed better than high A-Trait students on the familiar portion of the posttest; the reverse was true in Study II. In addition, low A-State students in Study II were found to perform significantly better than high A-State students on the familiar posttest, while there was no main effect of A-State in Study I. Thus, Drive Theory as an explanatory theory for these anxiety and performance results must be extended to take into account possible content related variables.

In summary, the findings of both Studies I and II indicated that the impact of the constructed response variable was paramount, in that students in this response mode condition had higher levels of state

anxiety, hostility, and poorer performance on the total technical posttest than students in the reading groups. The major findings of both studies, in general, supported Trait-State Anxiety Theory and replicated the effects of response modes and state anxiety on performance in a CAI task. However, the instructional treatment of shortening time spent on the CAI task was not effective in reducing state anxiety. On the familiar and initial technical posttest, shortening program length did prove effective in improving the performance of the constructed response group, which may have been due to decreased memory load for this group.

The present findings, therefore, would seem to indicate that it is not instructional time per se that is the critical variable for reducing state anxiety and improving performance. The intrinsic differences in the nature of the CAI learning task for the constructed response and reading group, including their differential affective and cognitive effects, imply the need to direct research efforts to the study of more relevant task variables.

Implications

The two studies which have been described were concerned with examining the effects of State and Trait anxiety in learning. Results of these studies, in general, support the fact that high anxiety disrupts performance. These results have led to our suggestion of future research, i.e., the reduction of anxiety in learning.

A problem of concern to educators is to determine the effects of anxiety on the learning of school subjects, and in particular, to discover appropriate means to reduce the disruptive effects of anxiety on learning. Although it has been recognized that anxiety can interfere with the learning process (Sarason, 1960; Spielberger, 1966), relatively little research has been concerned with reducing anxiety in the learning situation. A major reason for the scarcity of research in the area of anxiety reduction may be the theoretical and methodological confusion regarding the construct of anxiety and how it should be measured. However, with the recent formulation of the Trait-State Anxiety Theory (Spielberger, et al., 1970), it has been possible to differentiate conceptually between anxiety as a transitory state and as a relatively permanent trait.

With respect to a methodological solution to the confusion, several recent CAI studies have examined anxiety in the situation and have supported the contention that periodic A-State measures are needed to understand the relationship between anxiety and performance (Leherissey, O'Neil, and Hansen, 1970; O'Neil, Spielberger, and Hansen, 1969; O'Neil, Hansen, and Spielberger, 1969; O'Neil, 1969). These CAI studies have shown that it is possible methodologically not only to measure performance as a function of anxiety, but also to measure changes in A-State as a function of experimental treatment.

The implication of these conceptual and methodological distinctions for research in anxiety reduction is primarily that one can actually measure whether anxiety has been in fact reduced, rather than inferring this reduction on the basis of improved performance.

Most of the research studies which have been concerned with experimental treatments which reduce the disruptive effects of anxiety on performance have not measured A-State. In addition, they have used a behavioral or performance index from which anxiety reduction was inferred. Many of the treatments which have been employed have been shown to improve the performance of high anxious students and are us suggestive of appropriate anxiety reduction techniques. However, Leherissey, et al. (1970) showed that while memory support improved performance, it also increased state anxiety. Thus, it must be kept in mind that the techniques to be reviewed may or may not actually reduce state anxiety.

The continuation proposed of this grant offers a description of four studies which we feel will contribute both to a basic understanding of anxiety and also have immediate applied impact for anxiety reduction techniques.

The goal of the continuation proposal is to examine various anxiety reduction techniques on anxiety levels and performance. These techniques will range from instructional to clinical treatments and will be investigated in a range of computer-based situations. Four studies are proposed to accomplish these goals. The first study will focus on the effect of stimulating curiousity as an anxiety reducer. Next the impact of anxiety on a computer-based intelligence test will be first assessed and then reduced by assigning high anxious Ss to the least threatening form of test administration. Then the use of memory support to reduce anxiety will be further investigated.

The State-Trait Anxiety Inventory will be used to measure both trait and state anxiety (A-State). The materials will be presented by an IBM 1500 Computer-Assisted Instruction System which will also present the A-State scales and record S's responses and latencies.

REFERENCES

Chapeau, Peggie L. Test anxiety and feedback in programmed instruction. Journal of Educational Psychology, 1968, 59, 159-163

Cummings, Allana, & Goldstein, L. S. The effect of overt and covert responding on two kinds of learning tasks. Technical Report 620919. New York: Center for Programmed Instruction, 1962.

Fishman, Elizabeth J., Keller, L. and Atkinson, R. C. Massed versus distributed practice in computerized spelling drills. Journal of Educational Psychology, 1968, 59, 290-296.

Hughes, J. B., II, Sprague, J. L., & Bendig, A. W. Anxiety level, response alteration, and performance in serial learning. Journal of Psychology, 1954, 38, 421-426.

Hull, C. L. Principles of Behavior. New York: Appleton, 1943.

Kamin, L. J., & Fedorcahck, Olga. The Taylor scale, hunger and verbal learning. Canadian Journal of Psychology, 1957, II, 212-218.

Kight, H. R., & Sassenrath, J. M. Relationship of achievement motivation and test anxiety to performance in programmed instruction. Journal of Educational Psychology, 1966, 14, 185-191.

Leherissey, B. L., O'Neil, H. F., & Hansen, D. N. Effects of memory support on state anxiety and performance in computer assisted learning. Journal of Educational Psychology, in press.

Lucas, J. D. The interactive effects of anxiety, failure, and intraserial duplication. American Journal of Psychology, 1952, 65, 59-66.

Montague, E. K. The role of anxiety in serial rote learning. Journal of Experimental Psychology, 1953, 45, 91-96.

O'Neil, H. F. Effects of stress on state anxiety and performance in computer-assisted learning. Unpublished doctoral dissertation; Florida State University, 1969.

O'Neil, H. F. Effects of stress on state anxiety and performance in computer assisted learning. Tech Report No. VI, CAI Center, Florida State University, January, 1970.

O'Neil, H. F., Hansen, D. N., & Spielberger, C.D. Errors and latency of response as a function of anxiety and task difficulty. Paper presented at the American Education Research Association, Los Angeles, 1969.

O'Neil, H. F., Spielberger, C. D., & Hansen, D. N. The effects of state-anxiety and task difficulty on computer-assisted learning. In Press: Journal of Educational Psychology, 1969.

O'Reilly, R. P., & Ripple, R. E. The contribution of anxiety, creativity and intelligence to achievement with programmed instruction. Paper presented to the American Education Research Association, New York, 1967.

References - continued

Raymond, C. K. Anxiety and task as determiners of verbal performance. Journal of Experimental Psychology, 1953, 46, 120-124

Sarason, I. G. Empirical findings and theoretical problems in the use of anxiety scales. Psychological Bulletin, 1960, 57, 403-415.

Spence, K. W. Anxiety (drive) level and performance in eyelid conditioning. Psychological Bulletin, 1964, 61, 129-139

Spence, K. W. A theory of emotionally based drive (D) and its relationship to performance in simple learning situations. American Psychologist, 1958, 13, 131-141.

Spence, Janet T., & Spence, K. W. The motivational components of manifest anxiety: Drive & drive stimuli. In C. D. Spielberger (Ed.), Anxiety and behavior. New York: Academic Press, 1966, pp. 291-326.

Spielberger, C. D. Theory and research on anxiety. In C. D. Spielberger (Ed.), Anxiety and behavior. New York: Academic Press, 1966, pp. 3-20.

Spielberger, C. D., & Smith, L. H. Anxiety (drive), stress, and serial position effects in serial verbal learning. Journal of Experimental Psychology, 1966, 72, 589-595.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. Manual for the State-Trait Anxiety Inventory. Palo Alto, California: Consulting Psychologist Press, 1970.

Spielberger, C. D., Lushene, R. E., & McAdoo, W. G. Theory and measurement of anxiety states. In R. B. Cattell (Ed.), Handbook of Modern Personality Theory. Chicago: Aldine, 1971.

Taylor, Janet A. Drive theory and manifest anxiety. Psychological Bulletin, 1956, 53, 303-320.

Taylor, Janet A., & Chapman, Jean P. Anxiety and the learning of paired-associates. American Journal of Psychology, 1955, 68, 671.

Tobias, S. Effect of creativity, response mode, and subject matter familiarity on achievement from programmed instruction. Journal of Educational Psychology, 1969, 60, 453-460.

Tobias, S. The effect of creativity, response mode and subject matter familiarity on achievement from programmed instruction, New York: MSS Educational Publishing Company, 1968.

Tobias, S., & Abramson, T. The relationship of anxiety, stress, response mode and content difficulty to achievement in programmed instruction. Technical Report No. 4, Programmed Instruction Research Project. New York: City College, City University of New York, 1970.

References - continued

Tobias S., & Williamson, J. Anxiety and response to programmed instruction. Paper presented at the American Education Research Association, Chicago, 1968.